ENVIS CENTER
on
ENVIRONMENTAL BIOTECHNOLOGY

Abstract Vol. XXXIV

Sponsored by

MINISTRY OF ENVIRONMENT, FORESTS AND CLIMATE CHANGE
GOVERNMENT OF INDIA
NEW DELHI

Department of Environmental Science
University of Kalyani
Nadia, West Bengal
June 2019

Published by:
Prof. Ashis Kumar Panigrahi
Co-ordinator
ENVIS Centre on Environmental Biotechnology
Department of Environmental Science
University of Kalyani,
Kalyani –741235, Nadia,
West Bengal,
INDIA
Email: desku@envis.nic.in
Website: http://www.deskuenvis.nic.in

ENVIS CENTRE

on

ENVIRONMENTAL BIOTECHBNOLOGY

- **Prof. Ashis Kumar Panigrahi** : *Coordinator*, ENVIS Centre

ENVIS's Staff

1.	**Dr (Mrs.) Anusaya Mallick**	**:**	***Programme Officer***
2.	**Shri S. Banerjee**	**:**	***Information Officer***
3.	**Mr. Tanmoy Acharjee**	**:**	***IT Officer***
4.	**Mr. Subham Dutta**	**:**	***Data Entry Operator***

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 34th 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 June 2019. 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-markers can also be used to indicate exposure to various environmental substances in epidemiology and toxicology.

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

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

1. Bacterial Biofertilizer
2. Algal Biofertilizer

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

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

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

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

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

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

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

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

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

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

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

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 as 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

ZhizhenXu[a], WenhongFan[bc], ZhiweiShi[b], ChengTan[b], MinmingCui[b], ShichuanTang[a], GuangleQiu[d], XinbinFeng[d]. ([a]Key Laboratory of Occupational Safety and Health, Beijing Municipal Institute of Labor Protection, Beijing 100054, PR China [b]School of Space and Environment, Beihang University, Beijing 100191, PR China [c]Beijing Advanced Innovation Center for Big Data-Based Precision Medicine, Beihang University, Beijing 100191, PR China [d]State Key Laboratory of Environmental Geochemistry, Institute of Geochemistry, Chinese Academy of Sciences, Guiyang 550081, PR China). **Mercury and methylmercury bioaccumulation in a contaminated bay. Marine Pollution Bulletin, Volume 143 (2019):134-139**

The bioaccumulation and the main source of total Hg (THg) and methylmercury (MMHg) in the deposit-feeding polychaete *Neanthes japonica*collected in Jinzhou Bay, China, were investigated. Compared with the historical data, THg bioaccumulation in polychaetes collected in sediment of Jinzhou Bay was distinctly higher due to higher sediment THg concentration, but MMHg bioaccumulation was significantly lower. THg accumulation in polychaetes mainly derived from its accumulation in sediment. However, MMHg bioaccumulation in polychaetes did not correlate with Hg concentration in sediment. Besides sediment ingestion, MMHg accumulation in polychaetes may partially source from the process of in vivo transformation. The in vivo Hg methylation may take place in polychaetes, according to the excellent correlation between MMHg concentration and THg and inorganic Hg concentration in polychaetes. The biochemical characters in polychaete body, the oxidation-reduction environment and the microbial activity in polychaete gut may be beneficial to in vivo Hg methylation.

Keywords: Mercury; Methylmercury; Bioaccumulation; Methylation;

Wencheng Song[ab], Xiangxue Wang[a], Yubing Sun[ac], Tasawar Hayat[c], Xiangke Wang[acd]. ([a]MOE Key Laboratory of Resources and Environmental System Optimization, College of Environmental Science and Engineering, North China Electric Power University, Beijing 102206, PR China[b]Anhui Province Key Laboratory of Medical Physics and Technology, Center of Medical Physics and Technology, Hefei Institutes of Physical Science, Chinese Academy of Sciences, Hefei 230031, PR China[c]Collaborative Innovation Center of Radiation Medicine of Jiangsu Higher Education Institutions and School for Radiological and Interdisciplinary Sciences, Soochow University, 215123 Suzhou, PR China[d]NAAM Research Group, Faculty of Science, King Abdulaziz University, Jeddah 21589, Saudi Arabia) **Bioaccumulation and transformation of U(VI) by sporangiospores of *Mucor circinelloides.* Chemical Engineering Journal, Volume 362 (2019) : 81-88**

The bioaccumulation and transformation of U(VI) by sporangiospores of *Mucor circinelloides* under different environmental conditions (e.g., reaction time, pH, carbonate, sporangiospores concentration, and temperature) was investigated by batch, XPS and EXAFS techniques. The bioaccumulation kinetics and isotherms can be fitted by the pseudo-second-order kinetic mode and Langmuir model, respectively, due to the high correlation coefficient. The maximum bioaccumulation capacity of sporangiospores for U(VI) was 166.13 mg/g at pH

6.0, which was significantly higher than that of other mycelia or spores. The intracellular and extracellular morphology of sporangiospores were significantly changed after U(VI) bioaccumulation, and levels of intracellular H_2O_2, O_3^-, GPx and SOD compounds in sporangiospores increased significantly. XANES analysis confirmed that the intracellular U(VI) was reduced to U(IV) by sporangiospores, and U(IV) might be stably associated with oxygen-bearing functional groups by EXAFS analysis. These results show that the sporangiospores can be used a promising adsorbent for the bioaccumulation and transformation of U(VI) from aqueous solutions, which has important scientific significance for the immobilization of U(VI) in environmental remediation.

Keywords: Sporangiospores, Bioaccumulation, U(VI), XAFS

Xiangtao Jiang, Lili Tian, Yini Ma, Rong Ji. (State Key Laboratory of Pollution Control and Resource Reuse, School of the Environment, Nanjing University, 163 Xianlin Avenue, 210023 Nanjing, People's Republic of China) Quantifying the bioaccumulation of nanoplastics and PAHs in the clamworm *Perinereis aibuhitensis.* Science of The Total Environment, Volume 655(2019) : 591-597

The impact of nanometer-scale plastics (<1000 nm nanoplastics, NPs) on the bioaccumulation of hydrophobic organic pollutants, and especially polycyclic aromatic hydrocarbons (PAHs), in marine organisms has become of urgent concern. However, simultaneous determinations of the bioaccumulation of NPs and PAHs have been hindered by the lack of an efficient digestionmethod that removes background interference from the tissue without altering the surface properties of the plastic and destroying the PAHs. To solve this problem, an enzymatic digestion-based protocol using proteinase K and subsequent quantification methods were developed on a typical marine benthic invertebrate – the clamworm *Perinereis aibuhitensis*. Enzymatic digestion removed 91% of the biological tissues, comparable to the amount removed using 65% HNO_3 (93% removed) and better than that removed using 30% H_2O_2 or 10% KOH digestion (76% and 66%, respectively). After enzymatic digestion, roughly 92% of the NPs and 88% of the amount of pyrene were recovered, without significant modification of the NPs or pyrene degradation. By contrast, the NP and pyrene recovery achieved with HNO_3 digestion was only 1.4% and 0.1%, respectively. The newly developed protocol was successfully applied to a 96-h bioaccumulation study. The use of radioactively labeled ^{14}C-pyrene and fluorescently labeled NPs allowed the simultaneous quantification of NPs and PAHs in the clamworm and revealed a bioconcentration factor (BCF) of 1.96 ± 0.93 and 402.7 ± 47.0, respectively. The quantification of NPs and pyrene indicated that NP-adsorbed pyrene accounted for <1% of the total pyrene accumulation in the clamworm body when the concentration of NPs in seawater was as low as 0.4 mg/L. Our enzymatic digestion and dual-labeling technique thus provides the first reported BCF value of NPs in a marine benthic organism and new insights into the vector effects of these particles on the bioaccumulation of organic contaminants in a marine ecosystem.

Keywords: Nanoplastics, Enzymaticdigestion, Pyrene, Bioaccumulation

LiYang[ab], Wen-XiongWang[bc] ([a]Jiangsu Provincial Key Laboratory of Coastal Wetland Bioresources and Environmental Protection, Yancheng Teachers University, Yancheng, Jiangsu, 224051, China[b] Department of Ocean Science, Hong Kong University of Science and Technology, Clearwater Bay, Kowloon, Hong Kong[c] HKUST Shenzhen Research Institute, Shenzhen, 518057, China) Comparative contributions of copper nanoparticles

and ions to copper bioaccumulation and toxicity in barnacle larvae. Environmental Pollution. Volume 249 (2019) : 116-124

Cu nanoparticles (CuNPs) have been widely used in numerous products, and may become a potential threat to marine organisms, but their behavior in the marine environments and potential toxicity to marine organisms remain little known. In the present study, we investigated the behavior of CuNPs in seawater, as well as the toxicity and bioaccumulation of CuNPs and copper sulfate ($CuSO_4$) in barnacle larvae (*Balanus amphitrite*), a dominant foulinginvertebrate in marine environment. CuNPs tended to aggregate in natural seawater and released Cu ion rapidly into seawater. The aggregation and release were especially higher at a lower concentration of CuNPs, e.g., 94–96% of CuNPs were released as Cu ions at 20 μg/L after 24 h. The larger size of CuNPs (40 nm) tended to display a higher solubility than the 20 nm CuNPs did. Humic acids enhanced the aggregation and inhibited the dissolution of CuNPs, and had a protective effect on the survival of nauplii II at higher Cu concentrations (100–200 μg/L). Comparison of the lethal concentrations showed that CuNPs were generally less toxic to the two stages of barnacle larvae (nauplii II and VI) than the Cu ions. The calculated 48-h LC_{50} values for nauplii II were 189.5 μg/L, 123.2 μg/L, and 89.8 μg/L for 20 nm CuNPs, 40 nm CuNPs, and $CuSO_4$, respectively. However, the lethal concentrations of Cu bioaccumulation in the barnacle larvae were comparable between CuNPs and Cu ions when expressed by the actual tissue Cu bioaccumulation. Barnacle larval settlement decreased with an increase of Cu concentrations of both CuNPs and $CuSO_4$, and was significantly inhibited at 100 μg/L $CuSO_4$ and 150 μg/L CuNPs. Our results indicated that the toxicity of CuNPs could not be solely explained by the released Cu ions, and both CuNPs and the released Cu ion contributed to their toxicity and bioaccumulation in barnacle larvae.

Keywords: Copper nanoparticles, Toxicity, Barnacle larvae, Settlement, Bioaccumulation

Amanda N.Curtis[a], KimberlyBourne[b], Mark E.Borsuk[b], Kate L.Buckman[a], EugeneDemidenko[cd], Vivien F.Taylor[e], Celia Y.Chen[a]. ([a]Department of Biological Sciences, Dartmouth College, Hanover, NH 03755, United States[b]Department of Civil and Environmental Engineering, Duke University, Durham, NC 27708, United States[c]Department of Biomedical Data Science, Geisel School of Medicine, Dartmouth College, Hanover, NH 03755, United States[d]Department of Mathematics, Dartmouth College, NH 03755, United States[e]Department of Earth Science, Dartmouth College, Hanover, NH 03755, United States) **Effects of temperature, salinity, and sediment organic carbon on methylmercury bioaccumulation in an estuarine amphipod. Science of The Total Environment. Available online 7 June 2019**

Mercury (Hg) is a global contaminant that poses a human health risk in its organic form, methylmercury (MeHg), through consumption of fish and fishery products. Bioaccumulation of Hg in the aquatic environment is controlled by a number of factors expected to be altered by climate change. We examined the individual and combined effects of temperature, sediment organic carbon, and salinity on the bioaccumulation of MeHg in an estuarine amphipod, *Leptocheirus plumulosus*, when exposed to sediment from two locations in the Gulf of Maine (Kittery and Bass Harbor) that contained different levels of MeHg and organic carbon. Higher temperatures and lower organic carbon levels individually increased uptake of MeHg by *L. plumulosus*as measured by the biota-sediment accumulation factor (BSAF), while the

effect of salinity on BSAF differed by sediment source. Multi-factor statistical modeling using all data revealed a significant interaction between temperature and organic carbon for both sediments, in which increased temperature had a negative effect on BSAF at the lowest carbon levels and a positive effect at higher levels. Our results suggest that increased temperature and carbon loading, of a magnitude expected as a result from climate change, could be associated with a net decrease in amphipod BSAF of 50 to 71%, depending on sediment characteristics. While these are only first-order projections, our results indicate that the future fate of MeHg in marine food webs is likely to depend on a number of factors beyond Hg loading.

Keywords: Ocean warming, *Leptocheirus plumulosus*, Multi-factor models, Estuary Bioaccumulation

Brandon S.Gerig[a], Nathan T.Hermann[b], Dominic T.Chaloner[b], Gary A.Lamberti[b] ([a]Department of Biology, Northern Michigan University, Marquette, MI 49855, United States[b]Department of Biological Sciences, University of Notre Dame, Notre Dame, IN 46556) **Using a dynamic bioenergetics-bioaccumulation model to understand mechanisms of uptake and bioaccumulation of salmon-derived contaminants by stream-resident fish. Science of The Total Environment, Volume 652(2019) : 633-642**

Ecosystem linkages created by migratory organisms such as Pacific salmon (*Oncorhynchus* spp.) facilitate the transfer of ecologically beneficial resource subsidies and environmentally damaging contaminants to recipient food webs. In the Laurentian Great Lakes, introduced Pacific salmon accumulate large contaminant burdens that they disperse to streams during spawning in the form of carcass and gametic tissue, with uncertain consequences for stream food webs. Here, we describe a coupled bioenergetics-bioaccumulation model parameterized using empirical and literature-sourced data to predict the dual effect of Pacific salmon on stream-resident brook trout (*Salvelinus fontinalis*) growth and contaminant bioaccumulation. Within the model, we developed four unique scenarios to ascertain how the (1) trophic pathway to contamination, (2) level of salmon egg consumption, (3) intensity and duration of salmon exposure, and (4) age of first exposure to salmon, affected growth and contaminant bioaccumulation in brook trout. Our model demonstrated that salmon egg consumption increased brook trout growth and PCBbioaccumulation while reducing Hg tissue concentrations. Other trophic pathways, including direct carcass consumption and an indirect food web pathway, did not strongly influence growth or contaminant bioaccumulation. Our model also demonstrated that variation in the magnitude and temporal duration of salmon egg consumption mostly strongly influenced the growth and contaminant concentration of younger brook trout. Overall, our model highlighted that Pacific salmon transfer energy and contaminants but this balance is dictated by the food web pathway and plasticity in the diet of stream-resident fish. Our mechanistic, model-based evaluation of salmon contaminant biotransport can be extended to predict the impact of other migratory fishes on recipient food webs.

Keywords: Contaminant biotransport, Pacific salmon, Polychlorinated biphenyls, Mercury, Bioenergetics-bioaccumulation model, Ecosystem linkages

YongminWang[12], QingXie[1], QinqinXu[1], JinpingXue[1], ChengZhang[1], DingyongWang[2]. ([1]College of Resources and Environment, Southwest University, Chongqing 400715, China.[2]Chongqing Key Laboratory of Agricultural Resources and Environment, Chongqing 400715, China) **Mercury bioaccumulation in fish in an artificial lake used to carry out cage culture. Journal of Environmental Sciences. Volume 78(2019) :352-359**

As a global toxic pollutant, mercury (Hg) bioaccumulation within food chaincould be influenced by human disturbance. Ten typical fish species were collected from Changshou Lake, an artificial lake used to carry out cage fish culture, to investigate the C/N isotopic compositions and Hg bioaccumulation in fish. The results showed that the total Hg (THg) and methylmercury(MeHg) levels in fish muscles ((56.03 ± 43.96) and (32.35 ± 29.57) ng/g, wet weight), comparable with those in most studies in China, were significantly lower than the international marketing limit (0.5 mg/kg). Past human input for cage culture in this lake led to abnormal ^{15}N enrichment in food chain, as the quantitative trophic levels based on $\delta^{15}N$ were different with that classified by feeding behaviors. This phenomenon subsequently demonstrated that it should be considered thoughtfully with respect to the application of the traditional method for understanding Hg bioaccumulation power by the slope of $\log_{10}$[Hg] with $\delta^{15}N$ regression in specific water body (i.e., Changshou Lake). In addition, no significant linear correlation between Hg and body weight or length of some fish species was observed, suggesting that the fish growth in the eutrophic environment was disproportionate with Hg bioaccumulation, and fish length or weight was not the main factor affecting Hg transfer with food web. The occurrence of human disturbance in aquatic system presents a challenge to a better understanding of the Hg bioaccumulation and biomagnification within the food chain.

Keywords: Mercury, Methylmercury, Human disturbed lake, Bioaccumulation, N enrichment

Nicholas L.Rodenhouse[a], Winsor H.Lowe[b], Renate L.E.Gebauer[c], Kent P.McFarland[d], Michael S.Bank[ef] ([a]Wellesley College, Wellesley, MA, USA[b]Division of Biological Sciences, University of Montana, Missoula, MT, USA[c]Keene State College, Keene, NH, USA[d]Vermont Center for Ecostudies, Norwich, VT, USA[e]Department of Environmental Conservation, University of Massachusetts, Amherst, MA, USA[f]Institute of Marine Research, Postboks 1870, Nordnes 5817, Bergen, Norway) **Mercury bioaccumulation in temperate forest food webs associated with headwater streams. Science of The Total Environment, Volume 665(2019) :1125-1134**

The soils and food webs associated with mid to high elevation, forested, headwater streams in northeastern North America are potential hotspots for mercury (Hg) methylation and bioaccumulation, but are not well studied. Our goals were to quantify total Hg (THg) and methyl Hg (MeHg) concentrations in soils and terrestrial food webs associated with headwater streams of northern hardwood forests to identify predictors of small-scale spatial variation in Hg bioaccumulation. We sampled soil characteristics that promote Hg methylation including pH, sulfur and calcium content, and organic matter. To assess spatial variation, we sampled at high (~700 m asl) and mid elevations (~500 m asl), both adjacent to (<1 m) and away from (>75 m) three replicate headwater streams in each of two watersheds of the White Mountains region, New Hampshire, USA. Soils of these forested watersheds differed significantly in pH and the content of calcium, sulfur, organic matter and THg. Conditions for methylation were more favorable in the uplandforest sites compared to streamside sites. Significant bioaccumulation of THg occurred in all measured components of the food web, including insects, spiders, salamanders, and birds. Trophic position, as determined by $\delta^{15}N$, was the best predictor of both THg and MeHg bioaccumulation across the sampled taxa and was also a better predictor than spatial location. However, the degree of bioaccumulation at which MeHg significantly affects animal behavior, reproduction or survival is unknown for most taxa in

terrestrial habitats, particularly for invertebrates. These findings show that Hg methylation and bioaccumulation is not limited to areas traditionally classified as wetlands or to areas with exceptionally high THg inputs, but that it is a widespread and important phenomenon in the moist deciduous forestsof eastern North America.

Keywords Methylmercury, Salamanders, Terrestrial, Food webs, Stable isotopes, Headwater streams

Bioremediation

Samakshi Verma, Arindam Kuila. (Department of Bioscience and Biotechnology,Banasthali Vidyapith, Rajasthan 304022, India). Bioremediation of heavy metals by microbial process. Environmental Technology & Innovation, Volume 14, May (2019): 100369

Bioremediation is an inventive and optimistic technology which is applicable for the retrieval and reduction of heavy metals in water and polluted lands. Microorganism plays an essential part in bioremediation of heavy metals. By using genetic engineering, genetically modified organisms can be generated which can likely reduce different types of polycyclichydrocarbons (PAHs). Flavobacterium, Pseudomonas, Bacillus, Arthrobacter, Corynebacterium, Methosinus, Rhodococcus, Mycobacterium, Stereum hirsutum, Nocardia, Methanogens, Aspergilus *niger*, Pleurotus ostreatus, Rhizopus arrhizus, Azotobacter, Alcaligenes, Phormidium valderium, Ganoderma applantus are some microbial species that help in bioremediation of heavy metals. This review not only discussed about the importance of microbes for bioremediation of heavy metals but also discussed about the challenges and limitations of native and engineered bacteria for bioremediation. Significance of bioremediation with the help of genetically engineered bacteria is in light because of its eco-friendly nature and minimum health hazards other than the physio-chemical dependent strategies, which are less eco friendly and dangerous to life.

Keywords: Bioremediation; Heavy metals; Microorganisms; Biosorption; Genetically engineered bacteria; Polycyclic hydrocarbons

Rosa Posada-Baquero[a], Magdalena Grifoll[b], José-Julio Ortega-Calvo[a]. ([a]Instituto de Recursos Naturales y Agrobiología de Sevilla (IRNAS), C.S.I.C., Avenida Reina Mercedes, 10, E-41012 Seville, Spain[b]Univ Barcelona, Fac Biol, Dept Genet Microbiol & Stat, Diagonal 643, E-08028 Barcelona, Spain) Rhamnolipid-enhanced solubilization and biodegradation of PAHs in soils after conventional bioremediation Science of The Total Environment, Volume 668 (2019) : 790-796

The application of a rhamnolipid biosurfactant for enhanced solubilizationand biodegradation of slowly desorbing polycyclic aromatic hydrocarbons(PAHs) in contaminated soils was determined in this study. The soil samples exhibited different levels of pollution and different bioremediation stages: the first soil originated from a creosote-polluted site, contained 4370 mg kg $^{-1}$ of PAHs and had not been bioremediated; the second soil was the same as the first but had received bioremediation treatment with nutrient amendment in biopiles for a period of 5 months and contained 580 mg kg $^{-1}$ of PAHs after this treatment; the third soil was treated by

bioremediation for several years to reduce the concentration of PAHs to 275 mg kg^{-1}. The kinetics of PAH desorption were determined to assess the magnitude of the slowly desorbing fractions present in the polluted soil and to optimize the biosurfactant effectiveness in terms of biodegradation. The soils that had been treated by bioremediation were enriched in slowly desorbing PAHs. The rhamnolipid at a concentration above its critical micelle concentration enhanced biodegradation in the soils that had been bioremediated previously. The measurement of residual concentrations of native PAHs showed the promoting effect of the biosurfactant on the biodegradation of the slowly desorbing fractions. Interestingly, benzo(a)pyrene was biodegraded in the soil that had been bioremediated for a long time. Rhamnolipid can constitute a valid alternative to chemical surfactants in promoting the biodegradation of slow-desorption PAHs, which is one of the most important problems in bioremediation, but the efficiency depends strongly on the bioremediation stage in which the biosurfactant is applied.

Keywords: Biodegradation; Polycyclic aromatic hydrocarbons; Biosurfactants; Bioremediation

FuChen[ab], XiaoxiaoLi[a], QianlinZhu[b], JingMa[ac], HupingHou[b], ShaoliangZhang[b] ([a]Low Carbon Energy Institute, China University of Mining and Technology, Xuzhou, Jiangsu 221008, China[b]School of Environment Science and Spatial Informatics, China University of Mining and Technology, Xuzhou, Jiangsu 221008, China[c]Amap, Inra, Cnrs, Ird, Cirad, University of Montpellier, 34090 Montpellier, France) **Bioremediation of petroleum-contaminated soil enhanced by aged refuse. Chemosphere, Volume 222 (2019) : 98-105**

In this study, the effect of aged refuse on biodegradation of total petroleum hydrocarbons (TPH), microbial counts, soil ecotoxicity, dehydrogenase activity and microbial community compositions were investigated in solid phasereactors during a 30-week period. The results demonstrate that the removal efficiency of TPH was significantly higher in the soil supplemented with aged refuse than in the soil without aged refuse. After 30 weeks, the removal efficiencies of TPH in soils were 29.3%, 82.1%, 63.7% and 90.2% in the cases of natural attenuation, nutrient addition (with NH_4NO_3 and K_2HPO_4), supplement with 20% (w/w, dry weight basis) of aged refuse and the combination of nutrient and aged refuse. Nutrient plus aged refuse made the TPH concentration decrease to below the threshold level of commercial use required for Chinese soil quality for TPH (<3000 mg/kg) in 30 weeks. It was also found that dehydrogenase activity, bacterial counts and degrader abundance in the soil were remarkably enhanced by the addition of aged refuse (20%,w/w). Total organic carbon analysis demonstrates that large amounts of hydrocarbon intermediates occurred in the soil after bioremediation.

Keywords: Aged refuse; Bioremediation; Solid phase bioreactor; Dehydrogenase; Biostimulation

C.Castro M.S.Urbieta J.Plaza Cazón E.R.Donati. (CINDEFI (CONICET-CCT LA PLATA UNLP), Facultad de Ciencias Exactas, Universidad Nacional de La Plata, Calles 47 y 115, (1900), La Plata, Argentina) **Metal biorecovery and bioremediation: Whether or not thermophilic are better than mesophilic microorganisms. Bioresource Technology, Volume 279 (2019) : 317-326**

Metal mobilization and immobilization catalyzed by microbial action are key processes in environmental biotechnology. Metal mobilization from ores, mining wastes, or solid residues

can be used for recovering metals and/or remediating polluted environments; furthermore, immobilization reduces the migration of metals; cleans up effluents plus ground- and surface water; and, moreover, can help to concentrate and recover metals. Usually these processes provide certain advantages over traditional technologies such as more efficient economical and environmentally sustainable results. Since elevated temperatures typically increase chemical kinetics, it could be expected that bioprocesses should also be enhanced by replacing mesophiles with thermophiles or hyperthermophiles. Nevertheless, other issues like process stability, flexibility, and thermophile-versus-mesophile resistance to acidity and/or metal toxicity should be carefully considered. This review critically analyzes and compares thermophilic and mesophilic microbial performances in recent and selected representative examples of metal bioremediation and biorecovery.

Keywords: Metals; Tolerance; Biorecovery; Bioremediation; Thermophiles

XiaoKong[ab], DecaiJin[ab], XinTai[ac], HaoYu[ac], GuilanDuan[ab], XiulanYan[d], JiangangPan[e], JunhuaSong[f], YeDeng[ab]. ([a]Key Laboratory of Environmental Biotechnology, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, Beijing 100085, China[b]College of Resources and Environment, University of Chinese Academy of Sciences, Beijing 100049, China[c]College of Environmental Science and Engineering, Liaoning Technical University, Fuxin 123000, China[d]Key Laboratory of Land Surface Pattern and Simulation, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing 100101, China[e]School of Life Science and Technology, Inner Mongolia University of Science and Technology, Baotou 014010, China[f]Institute for the Control of Agrochemicals, China Ministry of Agriculture and Rural Affairs, Beijing 100026, China) **Bioremediation of dibutyl phthalate in a simulated agricultural ecosystem by *Gordonia*sp. strain QH-11 and the microbial ecological effects in soil. Science of The Total Environment, Volume 667 (2019) : 691-700**

Bioremediation of organic pollutants has been identified as an economically efficient and environmentally friendly method. Here, a pot experiment was conducted to evaluate the bioremediation efficiency of dibutyl phthalate (DBP) by *Gordonia phthalatica* sp. nov. QH-11 in agricultural soils, along with the effect of this exogenous organism on the native microbial community and ecosystem functions during the bioremediation process. The results showed that inoculation with strain QH-11 accelerated DBP degradation in the soiland decreased DBP accumulation in plants, thereby reducing the health risksassociated with vegetables grown in those soils. High-throughput sequencingdemonstrated that both DBP contamination and the bioremediation process significantly altered prokaryotic community composition, structure, and network interactions; however, these effects were greatly reduced after 30 d. Dibutyl phthalate affected the prokaryotic community by influencing soil properties rather than directly impacting on microorganisms. In addition, ecosystem functions, like the nitrogen cycle, were significantly altered. Contamination with DBP promoted nitrogen fixation and the denitrificationprocesses while inhibiting nitrification. Bioremediation may mitigate some of the changes to nitrogen cycling, helping to maintain the balance of prokaryotic community function. According to this study, bioremediation through highly efficient degradation bacteria may be a safe and promising method for reducing PAEs contamination in soil-vegetable systems.

Keywords: Dibutyl phthalate; Bioremediation; *Gordonia* sp.; Nitrogen cycle gene; Prokaryotic community

Chu-FangYang[a], Shu-HuiLiu[bc], Yu-MinSu[a], Yu-RongChen[a], Chi-WenLin[ad], Keng-LiLin[e] ([a]Department of Safety, Health and Environmental Engineering, National Yunlin University of Science and Technology, 123 University Rd., Sec. 3, Douliu, Yunlin 64002, Taiwan, ROC[b]Center for General Education, Yu Da University of Science and Technology, 168 Hsueh-fu Rd., Chaochiao Township, Miaoli 36143, Taiwan, ROC[c]Department of Health Care and Social Work, Yu Da University of Science and Technology, 168 Hsueh-fu Rd., Chaochiao Township, Miaoli 36143, Taiwan, ROC[d]National Yunlin University of Science and Technology, Feng Tay Distinguished Professor, Taiwan, ROC[e]AECOM Taiwan Corporation, Taiwan, ROC) **Bioremediation capability evaluation of benzene and sulfolane contaminated groundwater: Determination of bioremediation parameters. Science of The Total Environment, Volume 648 (2019) : 811-818**

Benzene and sulfolane are commonly used but hazardous chemicals in the petrochemical industry and their leakage and inappropriate disposal certainly causes serious soil and groundwater contamination. In this research, the bioremediation potential of groundwater contaminated with benzene and sulfolane was evaluated, and the operating parameters for bioremediation were established through laboratory batch experiments. Among the various bacterial consortia, the bacterial population of monitoring well c (MWc) contained the highest sulfolane and benzene removal efficiencies. When the dissolved oxygen (DO) level was >1 mg L^{-1}, the bacterial population of MWc showed excellent removal efficiencies toward high and low concentrations of benzene and sulfolane. The C:N:P ratio of 100:10:1 in media facilitated sulfolane and benzene biodegradation, and the degradation time was greatly reduced. Adding additional phosphate into real groundwater could slightly increase benzene removal efficiency. Trace elements only slightly enhanced benzene degradation. On the contrary, additional phosphate and trace elements supplementary did not enhance sulfolane degradation. However, sulfolane removal efficiency could be significantly improved through bioaugmentation of specific sulfolane degrading bacterium and 100% sulfolane removal efficiency was achieved.

Keywords: Sulfolane degradation; Biostimulation; Bioaugmentation; Groundwater; Dissolved oxygen

MohitKumar[a1], ShwetaJaiswal[b1], Kushneet KaurSodhi[a1], PalleeShree[a], Dileep KumarSingh[a], Pawan KumarAgrawal[c], PratyooshShukla[b]. ([a]Soil Microbial Ecology and Environmental Toxicology Laboratory, Department of Zoology, University of Delhi, Delhi 110007, India[b]Enzyme Technology and Protein Bioinformatics Laboratory, Department of Microbiology, Maharshi Dayanand University, Rohtak 124001, Haryana, India[c]National Agriculture Science Fund, Krishi Anusandhan Bhavan-I, Indian Agricultural Research Institute, Delhi 110012, India) **Antibiotics bioremediation: Perspectives on its ecotoxicity and resistance. Environment International, Volume 124 (2019) : 448-461**

Antibiotic is one of the most significant discoveries and have brought a revolution in the field of medicine for human therapy. In addition to the medical uses, antibiotics have broad applications in agriculture and animal husbandry. In developing nations, antibiotics use have helped to

increase the life expectancy by lowering the deaths due to bacterial infections, but the risks associated with antibiotics pollution is largely affecting people. Since antibiotics are released partially degraded and undegraded into environment creating antibiotic pollution, and its bioremediation is a challenging task. In the present review, we have discussed the primary antibiotic sources like hospitals, dairy, and agriculture causing antibiotic pollution and their innovative detection methods. The strong commitment towards the resistance prevention and participation, nations through strict policies and their implementations now come to fight against the antibiotic resistance under WHO. The review also deciphers the bacterial evolution based strategies to overcome the effects of antibiotics, so the antibiotic degradation and elimination from the environment and its health benefits. The present review focuses on the environmental sources of antibiotics, it's possible degradation mechanisms, health effects, and bacterial antibiotics resistance mechanisms.

Keywords: Antibiotics; Bioremediation; Biofilm; Microbial consortium; Degradation

Christiane Augusta DinizMelo[a], Ana Beatriz Rocha de JesusPassos[b], João CarlosMadalão[a], Daniel ValadãoSilva[c], André MarcosMassenssini[d], Antônio Albertoda Silva[a]Maurício DutraCosta[d]Matheus de FreitasSouza[c] ([a]Department of Crop Science, Universidade Federal de Viçosa, Av. P.H. Rolfs, s/n, Campus, 36570-900 Viçosa, MG, Brazil[b]Department of Chemistry, Universidade Federal do Espírito Santo, Cachoeiro do Itapemirim, ES, Brazil[c]Department of Crop Science, Universidade Federal Rural do Semi-Árido, Mossoró, Rio Grande do Norte, Brazil[d]Department of Microbiology, Universidade Federal de Viçosa, Av. P.H. Rolfs, s/n, Campus, 36570-900 Viçosa, MG, Brazil) **Bioaugmentation as an associated technology for bioremediation of soil contaminated with sulfentrazone. Ecological Indicators,Volume 99 (2019) : 343-348**

The association between remediation plants and bioenhancement with a bacterial consortium may improve the efficiency and accelerate the decontamination process of soils contaminated with herbicides. The objective of this work was to evaluate the potential for bioremediation of soils contaminated with sulfentrazone by using a previously selected bacterial consortium, namely, phytoremediator plants, and their combination. The treatments consisted of a single crop of *Canavalia ensiformis*, a single crop of *Helianthus annuus*, both species in mixed cultivation, tilled soil in association with the presence or absence of inoculation with a bacterial consortium and different bioremediation periods (25, 45, 65 and 85 days after thinning). At the end of each season, a bioassay was performed with the bioindicator species *Sorghum bicolor*, and the sulfentrazone residues were quantified in soil by high-performance liquid chromatography. The *Helianthus annuus* single crop and the mixed cultivation reduced by 64% the half-life of sulfentrazone in comparison to soil cultivated with *C. ensiformis* without inoculation and by 43% compared to the treatments composed of untilled soil and a single crop of *C. ensiformis* in the presence of inoculation, respectively. The mixed cultivation of *C. ensiformis* and *H. annuus* and the single crop of *H. annuus*, regardless of soil inoculation with the bacterial consortium, are the most efficient techniques of bioremediation of sulfentrazone in soil. Single-crop or mixed cultivation of these species on day 85 after thinning provides considerable reductions in the concentration of sulfentrazone in the soil; however, that period is not sufficient to allow the growth of the indicator plant without the occurrence of toxicity.

Keywords: Bioenhancement; Phytoremediation; Herbicide; Half-life time

Biotransformation

TakashiOhnuki MasahikoEjiri MasaakiKizuka MieFujiwara TakahideNishi. (Daiichi Sankyo RD Novare Co., Ltd., 1-16-13, Kitakasai, Edogawa-ku, Tokyo 134-8630, Japan) Practical one-step glucuronidation via biotransformation. Bioorganic & Medicinal Chemistry Letters, Volume 29, Issue 2 (2019) : 199-203

We herein report a practical one-step glucuronidation method by biotransformation using *Streptomyces* sp. SANK 60895. This novel direct method of biotransformation has been shown to be more practical and scalable for glucuronidation than previously reported chemical and enzymatic procedures given its simplicity, high β-selectivity, cost-effectiveness, and reproducibility. We applied the present method to the synthesis of acyl glucuronide and hydroxy-β-glucuronide of mycophenolic acid and compound **4**, respectively. This method was also shown to be applicable to the *N*-glucuronidation of various compounds.

Keywords: Glucuronidation; Biotransformation; Acyl glucuronide; SANK 60895

Justyna Popiół[ab], KamilPiska[b], Karolina Słoczyńska[b], AnnaBień[b], Dorota Żelaszczyk[a], Agnieszka Gunia-Krzyżak[a], Paulina Koczurkiewicz[b], Katarzyna Wójcik-Pszczoła[b], HenrykMarona[a], Elżbieta Pękala[b]. ([a]Department of Bioorganic Chemistry, Chair of Organic Chemistry, Faculty of Pharmacy, Jagiellonian University Medical College, Medyczna 9, 30-688 Krakow, Poland[b]Department of Pharmaceutical Biochemistry, Faculty of Pharmacy, Jagiellonian University Medical College, Medyczna 9, 30-688 Krakow, Poland) Microbial biotransformation of some novel hydantoin derivatives: perspectives for bioremediation of potential sunscreen agents. Chemosphere, Volume 234(2019): 108-115

Having identified novel hydantoin derivatives (compounds 1-5) demonstrating promising photoprotective capacity against UV radiation, and understainding the problem of the biotic and abiotic degradation of UV filters, the aim of the study was to evaluate their metabolic fate with the environmental fungus *Cunninghamella echinulata*. In parallel, compound 1 *in vitro* microsomal metabolic pattern was evaluated. Finally, *in silico* toxicity of test compounds and their biotransformation products was estimated, and parent compounds photostability was assessed. The study demonstrated the capacity for *C. echinulata* to metabolize 1-5, which were biotransformed to a greater extent than the standard UV filter. *O*-dealkylation of the side chains attached to the phenyl or hydantoin rings, and hydroxylation of the phenyl ring occurred during microbial transformation. *O*-dealkylation product was a unique metabolite observed in microsomal biotransformation of 1, being its intrinsic clearance in the medium category range. *In silico* study demonstrated that compounds 1-5 have low toxicity risk. Among the resulting metabolites, four can increase the risk of reproductive effects as shown by OSIRIS prediction. Noteworthy, all indicated metabolites belong to minor metabolites, except for compound 3 major metabolite. Moreover, the results of the photostability study showed that 1-5 were considered to be photostable. To sum up, the obtained *in vitro* biotransformation, photostability, and *in silico*toxicity results encourage further studies on hydantoin derivatives as potential UV photoprotective agents. The presented biotransformation profile of compounds 1-5 by *C. echinulata* suggests that these compounds may follow a similar biodegradation fate when released into the environment.

Keywords: Bioremediation; Biotransformation; *Cunninghamella;* Hydantoin derivatives;UV filters; Toxicity

Lorena Gonzalez-Gil[a], Marta Carballa[a], Philippe F.-X.Corvini[b], Juan M.Lema[a] ([a]Department of Chemical Engineering, School of Engineering, Universidade de Santiago de Compostela, Rúa Lope Gómez de Marzoa, E-15782 Santiago de Compostela, Spain[b]Institute for Ecopreneurship, School of Life Sciences, University of Applied Sciences and Arts Northwestern Switzerland, 4132 Muttenz, Switzerland) **Reversibility of enzymatic reactions might limit biotransformation of organic micropollutants. Science of The Total Environment, Volume 665 (2019) : 574-578**

Biotransformation of many organic micropollutants (OMPs) in sewage treatment plants is incomplete leading to their release into the environment. Recent findings suggest that thermodynamic aspects of the reaction as chemical equilibrium limit biotransformation, while kinetic parameters have a lower influence. Reversibility of enzymatic reactions might result in a chemical equilibrium between the OMP and the transformation product, thus impeding a total removal of the compound. To the best of our knowledge, no study has focused on proving the reversible action of enzymes towards OMPs so far. Therefore, we aimed at demonstrating this hypothesis through *in vitro*assays with bisphenol A (BPA) in the presence of kinase enzymes, namely acetate kinase and hexokinase, which are key enzymes in anaerobic processes. Results suggest that BPA is phosphorylated by acetate kinase and hexokinase in the presence of ATP (adenosine 5-triphosphate), but when the concentration of this co-substrate decreases and the enzymes loss their activity, the backward reaction occurs, revealing a reversible biotransformation mechanism. This information is particularly relevant to address new removal strategies, which up to now were mainly focused on modifying the kinetic parameters of the reaction.

Keywords: Anaerobic digestion; Bisphenol A; Chemical equilibrium; Kinases; Phosphorylation; Sewage treatment plant

Michael T.ZumsteinDamian E.Helbling. (School of Civil and Environmental Engineering, Cornell University, Ithaca, NY, 14853, USA) **Biotransformation of antibiotics: Exploring the activity of extracellular and intracellular enzymes derived from wastewater microbial communities. Water Research, Volume 155(2019): 115-123**

Evaluating the activity of extracellular and intracellular enzymes derived from wastewater microbial communities is essential to improve our fundamental understanding of micropollutant removal during wastewater treatment. To study biotransformations with respect to enzyme biogeography, we developed a method to separate soluble extracellular, extracellular polymeric substance (EPS)-bound, and intracellular enzymes from wastewater microbial communities and assessed the protease and peptidase activity of the resulting enzyme pools. We also evaluated the biotransformation of six antibiotics(amoxicillin, ampicillin, clindamycin, daptomycin, linezolid, and vancomycin) in each enzyme pool because we expect that the kinetics, pathways, and biogeography of antibiotic biotransformations influence the selection of antibiotic resistance within wastewater microbial communities and in downstream environments. Our results demonstrated that biotransformation rate constants varied among the tested antibiotics, and that the observed rank order was consistent across three wastewater treatment plants. Importantly, many of the observed biotransformations eliminated the functional groupsassociated with antibiotic activity. Furthermore, we found that β-lactam hydrolysis and

daptomycin hydrolysis were catalyzed by enzymes extracted from the EPS, while none of the tested antibiotics were biotransformed by soluble extracellular enzymes. Finally, our results demonstrated that the number of enzyme-catalyzed antibiotic transformations was larger for intracellular than for extracellular enzymes. Together, this study provides novel insights on the kinetics, pathways, and biogeography of antibiotic biotransformations performed by wastewater microbial communities and can be used to inform pathway prediction or the development of biodegradable chemicals.

Keywords: Biological wastewater treatment; Micropollutant biotransformation; Enzymatic activity; Antibiotics; Enzyme extraction

JinxiaLiu Guowei Zhong[1], WeiLiSandra Mejia Avendaño. (Department of Civil Engineering, McGill University, 817 Sherbrooke Street West, Montreal, Quebec H3A 0C3, Canada) **Isomer-specific biotransformation of perfluoroalkyl sulfonamide compounds in aerobic soil. Science of The Total Environment, Volume 651, Part 1 (2019) : 766-774**

As an important reservoir of pollutants, soil may play a critical role in altering isomer ratios of perfluorooctane sulfonate (PFOS) or PFOS precursors (PrePFOS) via microbial processes, but this possibility has not yet been investigated, as well as the feasibility of using PFOS isomer ratio for source tracking in PFOS contaminated sites. In the present study, *N*-ethyl perfluorooctane sulfonamide ethanol (EtFOSE) of the technical grade was incubated in soil microcosms for 105 days to examine isomer-specific transformation processes. Experimental data combined with a mathematical model suggest new biotransformation pathways leading to PFOS, including a direct pathway to produce PFOS via hydrolysis of the sulfonamide bond. A similar rate of biotransformation was observed for EtFOSE with an estimated half-life of 8.7 and 9.6 days for the branched and linear isomers, respectively, without statistical difference. Two transformation intermediates, *N*-ethyl perfluorooctanoic acid (EtFOSAA) and perfluorooctane sulfonamide (FOSA), also showed preferential biotransformation of branched isomers. On the contrary, one intermediate *N*-ethyl perfluorooctane sulfonamide (EtFOSA) showed the preferred transformation of the linear isomer with an estimated half-life of 80.8 and 11.2 days for the branched and linear isomers, respectively. As PFOS is likely to be generated through more than one pathway or one precursor, its final isomer ratio is collectively determined by several upstreamreactions, each having specific isomer-specific transformation kinetics. Though the soil showed enrichment of branched PFOS isomers during the 4-month incubation, compared to PFOS standards, some uncertainty arises in concluding preferential generation of branched PFOS from its precursors, due to the lack of standards for branched PreFOS. The complexity of isomer-specific biotransformation only reinforced the challenge of applying the PFOS isomer ratio for source tracking in environmental microbial systems.

Keywords: PFOS; PFOS precursor; Biotransformation; Isomer-specific; Soil; Environmental fate

LorenaGonzalez-Gil[a], DanielKrah[b], Ann-KathrinGhattas[b], MartaCarballa[a], ArneWick[b], LissaHelmholz[b], Juan M.Lema[a], Thomas A.Ternes[b] ([a]Department of Chemical Engineering, School of Engineering, Universidade de Santiago de Compostela, Rúa Lope Gómez de Marzoa, Santiago de Compostela, E-15782, Spain[b]Federal Institute of Hydrology (BfG), Am Mainzer Tor 1, Koblenz, D-56068, Germany) **Biotransformation of**

organic micropollutants by anaerobic sludge enzymes. Water Research, Volume 152 (2019) : 202-214

Biotransformation of organic micropollutants (OMPs) in wastewater treatment plants ultimately depends on the enzymatic activities developed in each biological process. However, few research efforts have been made to clarify and identify the role of enzymes on the removal of OMPs, which is an essential knowledge to determine the biotransformation potential of treatment technologies. Therefore, the purpose of the present study was to investigate the enzymatic transformation of 35 OMPs under anaerobic conditions, which have been even less studied than aerobic systems. Initially, 13 OMPs were identified to be significantly biotransformed (>20%) by anaerobic sludge obtained from a full-scale anaerobic digester, predestining them as potential targets of anaerobic enzymes. Native enzymes were extracted from this anaerobic sludge to perform transformation assays with the OMPs. In addition, the effect of detergents to recover membrane enzymes, as well as the effects of cofactors and inhibitors to promote and suppress specific enzymatic activities were evaluated. In total, it was possible to recover enzymatic activities towards 10 out of these 13 target OMPs (acetyl-sulfamethoxazole and its transformation product sulfamethoxazole, acetaminophen, atenolol, clarithromycin, citalopram, climbazole, erythromycin, and terbutryn, venlafaxine) as well as towards 8 non-target OMPs (diclofenac, iopamidol, acyclovir, acesulfame, and 4 different hydroxylated metabolites of carbamazepine). Some enzymatic activities likely involved in the anaerobic biotransformation of these OMPs were identified. Thereby, this study is a starting point to unravel the still enigmatic biotransformation of OMPs in wastewater treatment systems.

Keywords: Anaerobic digestion; Degradation; Enzymatic transformation; Enzymatic pathways; Pharmaceuticals; Sewage treatment plant

I.Hussain[a], A.Singh[b], N.B.Singh[b], A.Singh[b], P.Singh[b] ([a]Department of Botany, Govt. Degree College, Kargil 194103, J&K, India[b]Plant Physiology Laboratory, Department of Botany, University of Allahabad, Allahabad 211002, UP, India) **Plant-nanoceria interaction: Toxicity, accumulation, translocation and biotransformation. South African Journal of Botany, Volume 121 (2019) : 239-247**

The fast development and use of cerium oxide nanoparticles (nanoceria) in the medical, consumer and industrial products have raised concerns among the world scientific community regarding risk linked with the discharge of nanoceria in the environment. The interactions between nanoceria and cropplants are of serious concern, as crop plants closely interact with the components of biosphere and represent one of the major routes of exposure for human beings. In the toxicity examination of plant–nanoceria interaction, the most vital need is to assemble relations between the shape, size, concentration and morphology of nanoceria with phytotoxicity. This article reviewed the recent studies on the uptake, translocation and biotransformation of nanoceria and their effects on biophysical and various biochemical parameters of plants. The accumulation, biotransformation, biomagnification and toxicity of nanoceria at higher trophic levels need to be addressed in further studies.

Keywords: Biomagnification; Biosphere; Phytotoxicity; Nanoceria

KeHuang[a], HanyongPeng[b], FanGao[a], QingQingLiu[b], XiufenLu[b], QirongShen[a], X. ChrisLe[b], Fang-JieZhao[a] ([a]Jiangsu Key Laboratory for Organic Waste Utilization, Jiangsu Collaborative Innovation Center for Solid Organic Waste Resource Utilization, College of

Resources and Environmental Sciences, Nanjing Agricultural University, Nanjing, 210095, China[b]Division of Analytical and Environmental Toxicology, Department of Laboratory Medicine and Pathology, University of Alberta, Edmonton, Alberta, T6G 2G3, Canada) Biotransformation of arsenic-containing roxarsone by an aerobic soil bacterium *Enterobacter* sp. CZ-1. Environmental Pollution, Volume 247 (2019) : 482-487

Roxarsone (3-nitro-4-hydroxyphenylarsonic **acid**, ROX) is an arsenic-containing compound widely used as a feed **additive** in **poultry** industries. ROX excreted in **chicken manure** can be transformed by **microbes** to different **arsenic** species in the environment. To date, most of the studies on microbial transformation of ROX have focused on anaerobic microorganisms. Here, we isolated a pure cultured aerobic ROX-transforming bacterial strain, CZ-1, from an arsenic-contaminated **paddy soil**. On the basis of 16S rRNA gene sequence, strain CZ-1 was classified as a member of the genus ***Enterobacter***. During ROX **biotransformation** by strain CZ-1, five **metabolites** including **arsenate** (As[V]), **arsenite** (As[III]), N-acetyl-4-hydroxy-m-arsanilic acid (N-AHPAA), 3-amino-4-hydroxyphenylarsonic acid (3-AHPAA) and a novel sulfur-containing arsenic species ($AsC_9H_{13}N_2O_6S$) were detected and identified based on high-performance liquid chromatography-inductively coupled **plasma**mass spectrometry (HPLC-ICP-MS), HPLC-ICP-MS/electrospray **ionization**mass spectrometry (ESI-MS) and HPLC-electrospray ionization **hybridquadrupole** time-of-flight mass spectrometry (ESI-qTOF-MS) analyses. N-AHPAA and 3-AHPAA were the main products, and 3-AHPAA could also be transformed to N-AHPAA. Based on the results, we propose a novel ROX biotransformation pathway by ***Enterobacter***. sp CZ-1, in which the nitro group of ROX is first reduced to amino group (3-AHPAA) and then acetylated to N-AHPAA.

Keywords: Arsenic; Biotransformation; ***Enterobacter*** sp.; Feed additive; Roxarsone

FaisalFahdBrianVeitchFaisalKhan. (Centre for Risk, Integrity and Safety Engineering (C-RISE), Faculty of Engineering and Applied Science, Memorial University of Newfoundland, St. John's, NL A1B 3X5, Canada) Arctic marine fish 'biotransformation toxicity' model for ecological risk assessment. Marine Pollution Bulletin, Volume 142 (2019) : 408-418

Oil and gas exploration and marine transport in the Arctic region have put the focus on the ecological risk of the possibly exposed organisms. In the present study, the impacts of sea ice, extreme light regime, various polar region-specific physiological characteristics in polar cod (*Boreogadus saida*) and their effects on xenobiotic distribution and metabolism are studied. A Bayesian belief network is used to model individual fish toxicity. The enzyme activity in the fish liver and other pertinent organs is used as a proxy for cellular damage and repair and is subsequently linked to toxicity in polar cod. Seasonal baseline variation in enzyme production is also taken into consideration. The model estimates the probability of exposure concentration to cause cytotoxicity and circumvents the need to use the traditionally obtained No Observed Effect Concentration (NOEC). Instead, it uses biotransformationenzyme activity as a basis to estimate the probability of individual cell damages.

Keywords: Ecological risk; Arctic risk;Oil spill; Biotransformation toxicity; Marine risk; Toxicodynamics; Toxicokinetics

Lúcia H.M.L.M.Santos[a], AnnaFreixa[a], SaraInsa[a], VicençAcuña[a], JosepSanchís[b], MarinellaFarré[b], SergiSabater[ac], DamiàBarceló[ab], SaraRodríguez-Mozaz[a] ([a]Catalan Institute for Water Research (ICRA), Carrer Emili Grahit 101, 17003 Girona, Spain[b]Department of Environmental Chemistry, IDAEA, CSIC, Jordi Girona 18-26, 08034 Barcelona, Spain[c]Institute of Aquatic Ecology, University of Girona, Campus de Montivili, 17071 Girona, Spain) **Impact of fullerenes in the bioaccumulation and biotransformation of venlafaxine, diuron and triclosan in river biofilms. Environmental Research, Volume 169 (2019) : 377-386**

A huge variety of organic microcontaminants are presently detected in freshwater ecosystems, but there is still a lack of knowledge about their interactions, either with living organisms or with other contaminants. Actually, carbon nanomaterials like fullerenes (C_{60}) can act as carriers of organic microcontaminants, but their relevance in processes like bioaccumulation and biotransformation of organic microcontaminants by organisms is unknown. In this study, mesocosm experiments were used to assess the bioaccumulation and biotransformation of three organic microcontaminants (venlafaxine, diuron and triclosan) in river biofilms, and to understand how much the concomitant presence of C_{60} at environmental relevant concentrations could impact these processes. Results indicated that venlafaxine exhibited the highest bioaccumulation (13% of the initial concentration of venlafaxine in water), while biotransformation was more evident for triclosan (5% of the initial concentration of triclosan in water). Furthermore, biotransformation products such as methyl-triclosan were also present in the biofilm, with levels up to 42% of the concentration of accumulated triclosan. The presence of C_{60} did not involve relevant changes in the bioaccumulation and biotransformation of microcontaminants in biofilms, which showed similar patterns. Nevertheless, the study shows that a detailed evaluation of the partition of the organic microcontaminants and their transformation products in freshwater systems are important to better understand the impact of the co-existence of others microcontaminants, like carbon nanomaterials, in their possible routes of bioaccumulation and biotransformation.

Keywords: Emerging microcontaminants; Nanoparticles; Transformation products; River biofilms; Co-exposure

Biomarker

FabianMaass[a1], IsabelSchulz[b1], PaulLingor[d], BritMollenhauer[ac,] [1]MathiasBähr[a] ([a]University Medical Center, Department of Neurology, Robert-Koch Strasse 40, 37075 Goettingen, Germany[b]University of Southampton, Faculty of Medicine, 12 University Rd, Southampton SO17 1BJ, United Kingdom[c]Paracelsus-Elena-Klinik, Klinikstrasse 16, 24128 Kassel, Germany[d]Department of Neurology, Klinikum rechts der Isar der Technischen Universität München, Ismaninger Straße 22, 81675 Munich, Germany) **Cerebrospinal fluid biomarker for Parkinson's disease: An overview. Molecular and Cellular Neuroscience, Volume 97 (2019) : 60-66**

In Parkinson's disease (PD), there is a wide field of recent and ongoing search for useful biomarkers for early and differential diagnosis, disease monitoring or subtype characterization. Up to now, no biofluid biomarker has entered the daily clinical routine. Cerebrospinal fluid (CSF) is often used as a source for biomarker development in different neurological disorders because it reflects changes in central-nervous system homeostasis. This review article gives an overview about different biomarker approaches in PD, mainly focusing on CSF analyses. Current state and future perspectives regarding classical proteinmarkers like alpha-synuclein, but also different "omics" techniques are described. In conclusion, technical advancements in the field already yielded promising results, but further multicenter trials with well-defined cohorts, standardized protocols and integrated data analysis of different modalities are needed before successful translation into routine clinical application.

Keywords: Parkinson's disease; Biomarker; CSF

NayaraGouveia[a], Carolina R.M.Oliveira[a], Camila P.Martins[a], Luciane A.Maranho[a], Camilo DiasSeabra Pereira[a], Manoela R.de Orte[a]Cyntia A.Y.Harayashiki[a]Sérgio M.Almeida[b]Italo B.Castro[a] ([a]Departamento de Ciências Do Mar, Universidade Federal de São Paulo (UNIFESP), Rua Carvalho de Mendonça 144, CEP, 11070-100, Santos, Brazil[b]Departamento de Biologia, Universidade Católica de Pernambuco, R. Do Príncipe 526, CEP, 50050-900, Recife, Brazil) **Can shell alterations in limpets be used as alternative biomarkers of coastal contamination? Chemosphere, Volume 224 (2019) : 9-19**

The present study evaluated the association among traditional biochemical biomarkers with biometric, morphometric, and elemental composition of *Lottia subrugosa* (patelliform gastropod) shells from three multi-impacted coastal areas in Brazil. The study was carried out in Todos os Santos Bay (TSB), Santos/São Vicente Estuarine System (SESS) and Paranaguá Estuarine Complex (CEP), using three sampling sites to seek contamination gradients in each area. Results showed that all biomarkers evaluated responded to environmental contamination, regardless the presence (SESS and CEP) or absence (TSB) of a gradient of contamination. The responses found using biometric and morphometric parameters were consistent with the traditional biomarkers of exposure and effects (lipid peroxidation and DNA damage). Indeed, changes in elemental composition of *L. subrugosa* shells suggest that exposure to contaminated environments is probably responsible for the alterations detected. Despite the simplicity and lower cost of biometric and morphometric analyzes, these parameters are influenced by natural environmental conditions from which biases may arise. Therefore, these tools should be evaluated through experimental studies before it can be used in future assessments. However, the findings from the present study were observed in three aquatic systems distributed over a wide range of latitudes, which indicates that gastropod shells reflect effects resulting from environmental contamination.

Keywords: *Lottia subrugosa;* Pollution; Effects; Shell; Biomarker

Stephen F.Carter[1], KarlHerholz[1], PedroRosa-Neto[234], LucPellerin[56], AgnetaNordberg[78], Eduardo R.Zimmer[910111213] ([1]Wolfson Molecular Imaging Centre, Division of Neuroscience and Experimental Psychology, University of Manchester, Manchester, United Kingdom[2]Translational Neuroimaging Laboratory, McGill Centre for Studies in Aging, McGill University, Montreal, Canada[3]Douglas Hospital Research Centre, Montreal,

Canada[4]Montreal Neurological Institute, Montreal, Canada[5]Département de Physiologie, Université de Lausanne, Lausanne, Switzerland[6]Centre de Résonance Magnétique des Systèmes Biologiques, UMR5536 CNRS, LabEx TRAIL-IBIO, Université de Bordeaux, Bordeaux Cedex 33760, France[7]Division of Clinical Geriatrics, Department of Neurobiology, Care Sciences, and Society, Karolinska Institutet, Stockholm, Sweden[8]Theme Aging, Karolinska University Hospital, Huddinge, Sweden[9]Department of Pharmacology, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil[10]Graduate Program in Biological Sciences: Biochemistry, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil[11]Graduate Program in Biological Sciences: Pharmacology and Therapeutics, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil[12]Brain Institute (BraIns) of Rio Grande do Sul, Porto Alegre, Brazil[13]Website: www.zimmer-lab.org) ,Volume 25, Issue 2 (2019) : 77-95

Astrocytic contributions to Alzheimer's disease (AD) progression were, until recently, largely overlooked. Astrocytes are integral to normal brain functionand astrocyte reactivity is an early feature of AD, potentially providing a promising target for preclinical diagnosis and treatment. Several *in vivo* AD biomarkers already exist, but presently there is a paucity of specific and sensitive *in vivo* astrocyte biomarkers that can accurately measure preclinical AD. Measuring monoamine oxidase-B with neuroimaging and glial fibrillary acidic protein from bodily fluids are biomarkers that are currently available. Developing novel, more specific, and sensitive astrocyte biomarkers will make it possible to pharmaceutically target chemical pathways that preserve beneficial astrocytic functions in response to AD pathology. This review discusses astrocyte biomarkers in the context of AD.

Keywords: Alzheimer's disease; astrocytes; biomarkers; fluid; imaging

Rodolfo CordeiroGiunchetti[a1], PatriciaSilveira[a1], Lucilene AparecidaResende[a], Jaqueline CostaLeite[a], Otoni Alvesde Oliveira Melo-Júnior[a], Marina LuizaRodrigues Alves[a]Laís MoreiraCosta[a]Daniel FerreiraLair[a]Vinícius RossiChaves[a]Ingriddos Santos Soares[a]Ludmila Zanandreisde Mendonça[a]Mariana FerreiraLanna[a]Helen SilvaRibeiro[a]Ana AliceMaia Gonçalves[a]Bruno MendesRoatt[b]Rodrigo Dian OliveiraAguiar-Soares[b]JulianaVitoriano-Souza[b]Nádiadas Dores Moreira[b]Fernando AugustoSiqueira Mathias[b]Jamille Mirellede Oliveira Cardoso[b]WendelCoura-Vital[c]Alexsandro SobreiraGaldino[d]Kelvinson FernandesViana[e]Olindo AssisMartins-Filho[f]Deniseda Silveira-Lemos[f]Walderez OrnelazDutra[a]Alexandre BarbosaReis[bc] ([a]Laboratory of Biology of Cell Interactions, Department of Morphology, Institute of Biological Sciences, Federal University of Minas Gerais, CEP 31270-901, Belo Horizonte, MG, Brazil[b]Laboratory of immunopathology, Nucleus of Research in Biological Sciences, Federal University of Ouro Preto, CEP 35400-000, Ouro Preto, MG, Brazil[c]Department of Clinical Analysis, School of Pharmacy, Federal University of Ouro Preto, CEP 35400-000, Ouro Preto, MG, Brazil[d]Laboratory of Biotechnology of Microorganisms, Federal University of São João Del-Rei, CEP 35501-296, Divinópolis, MG, Brazil[e]Laboratory of Biochemistry and Molecular Biology, Latin American Institute of Life and Nature Sciences, Federal University of Latin American Integration, CEP 85870-901, Foz do Iguaçu, PR, Brazil[f]Laboratory of Diagnostic and Monitoring Biomarkers, René Rachou Institute, FIOCRUZ-Minas, CEP 30190-002, Belo Horizonte, MG, Brazil) Canine visceral leishmaniasis biomarkers and their employment in vaccines. Veterinary Parasitology, Volume 271 (2019): 87-97

The natural history of canine visceral leishmaniasis (CVL) has been well described, particularly with respect to the parasite load in different tissues and immunopathological changes according to the progression of clinical forms. The biomarkers evaluated in these studies provide support for the improvement of the tools used in developing vaccines against CVL. Thus, we describe the major studies using the dog model that supplies the rationale for including different biomarkers (tissue parasitism, histopathology, hematological changes, leucocytes immunophenotyping, cytokines patterns, and *in vitro* co-culture systems using purified T-cells subsets and macrophages infected with *L. infantum*) for immunogenicity and protection evaluations in phases I and II applied to pre-clinical and clinical vaccine trials against CVL. The search for biomarkers related to resistance or susceptibility has revealed a mixed cytokine profile with a prominent proinflammatory immune response as relevant for *Leishmania* replication at low levels as observed in asymptomatic dogs (highlighted by high levels of IFN-γ and TNF-α and decreased levels in IL-4, TGF-β and IL-10). Furthermore, increased levels in $CD4^+$ and $CD8^+$ T-cell subsets, presenting intracytoplasmic proinflammatory cytokine balance, have been associated with a resistance profile against CVL. In contrast, a polyclonal B-cell expansion towards plasma cell differentiation contributes to high antibody production, which is the hallmark of symptomatic dogs associated with high susceptibility in CVL. Finally, the different studies used to analyze biomarkers have been incorporated into vaccine immunogenicity and protection evaluations. Those biomarkers identified as resistance or susceptibility markers in CVL have been used to evaluate the vaccine performance against *L. infantum* in a kennel trial conducted before the field trial in an area known to be endemic for visceral leishmaniasis. This rationale has been a guiding force in the testing and selection of the best vaccine candidates against CVL and provides a way for the veterinary industry to register commercial immunobiological products.

Keywords: Canine visceral leishmaniasis; Immunopathology; Vaccine; Immunogenicity; biomarkers

N.Aggerholm-Pedersen∗†, K.Maretty-Kongstad‡, J.Keller§A.Safwat∗ (∗Department of Oncology, Sarcoma Centre of Aarhus, Aarhus University Hospital, Aarhus, Denmark†Department of Experimental Clinical Oncology, Sarcoma Centre of Aarhus, Aarhus University Hospital, Aarhus, Denmark‡Department of Pathology, Sarcoma Centre of Aarhus, Aarhus University Hospital Aarhus, Denmark§Department of Orthopaedics, Sarcoma Centre of Aarhus, Aarhus University Hospital, Aarhus, Denmark) **Serum Biomarkers as Prognostic Factors for Metastatic Sarcoma. Clinical Oncology, Volume 31, Issue 4 (2019) : 242-249**

To investigate the prognostic value of combining inflammatory biomarkers in a prognostic index (Aarhus composite biomarker score: ACBS), adjusted for known confounders, including comorbidity, in patients with metastatic sarcoma.

All patients diagnosed with metastatic sarcoma from 1993 until 2008 were extracted from the Aarhus sarcoma database. The levels of serum albumin, C-reactive protein, serum sodium, haemoglobin, neutrophils and lymphocyteswere collected. ACBS as well as the neutrophil to lymphocyte ratio (NLR), Glasgow prognostic score (GPS) and a combined score of GPS and

NLR known as CNG were calculated. The prognostic importance of the biomarkers on disease-specific mortality was analysed. Adjustments were made for age, comorbidity, histological type and site of metastasis using the Cox proportional hazard model. Harrell's concordance index (C-index) was used to evaluate whether the ACBS adds prognostic information to already known prognostic factors. The data were validated using the bootstrapping method.

In total, 265 patients with metastatic sarcoma were included. The 2-year disease-specific mortality was 74% (95% confidence interval 68–80) and 79% (95% confidence interval 68–88) for soft-tissue sarcoma and bone sarcoma, respectively. Comorbidity was present in 21% of soft-tissue sarcoma patients and 13% of the bone sarcoma patients. All six biomarkers were independent prognostic factors. The various scoring systems (NLR, GPS, CNG and ACBS) combining more than one biomarker were also prognostic for disease-specific mortality.

The biomarker scoring systems are independent prognostic factors for adult patients with metastatic sarcoma. However, a modified ACBS was superior to all the other scoring systems in predicting outcome.

Keywords: Inflammation; Sarcoma; Serum biomarkers

Khalid BinWaleed[ab], LiliWang[b], GaryTse[cd], XiaomengYin[a], XiaoleiYang[a], BailingDai[a], YangLiu[a], ZhaoWang[a], XuminGuan[a], LianjunGao[a], De Greef Yves[e] Riccardo Cappato[fg] ShulinWu[h] Yunlong Xia[a] ([a]Department of Cardiology, The First Affiliated Hospital of Dalian Medical University, Dalian, China[b]Department of Cardiology, Fuwai Hospital Chinese Academic of Medical Sciences Shenzhen, Shenzhen, China[c]Department of Medicine and Therapeutics, Chinese University of Hong Kong, Hong Kong, China[d]Li Ka Shing Institute of Health Sciences, 30-32 Ngan Shing St, Chinese University of Hong Kong, Hong Kong, China[e]Electrophysiology Unit, ZNA Middelheim, Antwerp, Belgium[f]Humanitas Clinical and Research Center, via Manzoni 56, 20089, Rozzano, Milan, Italy[g]Humanitas University, Department of Biomedical Sciences, via Rita Levi Montalcini 420090, Pieve Emanuele, Milan, Italy[h]Department of Cardiovascular, Atrial Fibrillation Center, Guangdong Cardiovascular Institute, Guangdong General Hospital, Guangdong Academy of Medical Sciences, Guangzhou, China) **Data for short and long-term prothrombotic biomarkers after cryoballoon and radiofrequency ablation. Data in Brief, (2019): 10.1016/j.dib.2019.104105**

Data presented in this article are supplementary analyzed tables and individual raw data to our research article entitled “Short and long-term changes in platelet and inflammatory biomarkers after cryoballoon and radiofrequency ablation (Bin Waleed K et al., 2019) [1]”. These supplementary analyzed tables and individual raw data included platelet activation biomarkers [P-selectin (CD62P), CD40 ligand (CD40L), platelet factor-4 (PF-4), mean platelet volume (MPV), platelet-leukocyte ratio (P-LCR), and platelet distribution width (PDW)]; and inflammatory biomarkers [high sensitivity CRP (hs-CRP) and interleukin-6 (IL-6)] after cryoballoon (CB) and radiofrequency (RF) ablation. The provided raw data are intended to show the difference at short and long-term in platelet and inflammatory biomarkers values between CB and RF ablation.

Keywords: Atrial fibrillation; cryoballoon; radiofrequency; prothrombotic biomarkers

HenrikZetterberg[abcd] ([a]Department of Psychiatry and Neurochemistry, Institute of Neuroscience and Physiology, The Sahlgrenska Academy at the University of Gothenburg, Mölndal, Sweden[b]Clinical Neurochemistry Laboratory, Sahlgrenska University Hospital, Mölndal, Sweden[c]Department of Neurodegenerative Disease, UCL Institute of Neurology, Queen Square, London, UK[d]UK Dementia Research Institute at UCL, London, UK) Blood-based biomarkers for Alzheimer's disease—An update. Journal of Neuroscience Methods, Volume 319 (2019) : 2-6

Cerebrospinal fluid (CSF) biomarkers for Alzheimer's disease (AD) are in clinical use in many parts of the world and show good to excellent diagnostic accuracy in regards to identifying cerebral amyloid β (Aβ) and tau pathology irrespective of the clinical stage of the disease. However, CSF sampling is more difficult than a blood draw and a procedure only rarely performed by general practitioners. Since AD is such a common disease and since intense research on novel treatments that hopefully will be directed against underlying pathologies is moving forward, it would be excellent if the CSF tests for AD could be transformed into blood tests, as well as if novel blood biomarkers could be discovered. Brain-derived molecules are, however, present at much lower concentrations in blood than in CSF, which poses an analytical challenge. There are also additional issues with blood as a biofluid in which to measure biomarkers for central nervous system disease. Nevertheless, the past few years have seen an enormous development in the field of ultrasensitive measurement techniques. There is also much better availability of deeply phenotyped clinical cohorts for biomarker discovery and validation. This review gives an updated account of the current state of research on blood biomarkers for AD and related neurodegenerative dementias with special emphasis on findings that have been replicated by more than one research group.

Keywords: Alzheimer's disease; Biomarkers; CSF; Plasma; Tau; Amyloid; Neurofilament

Biofertilizer

MengWang[a], ShibaoChen[a], YunHan[a], LiChen[b], DuoWang[c] ([a]Key Laboratory of Plant Nutrition and Fertilizer, Ministry of Agriculture / Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, Beijing, 100081, PR China[b]Institute of Plant Protection and Environmental Protection, Beijing Academy of Agriculture and Forestry Science, Beijing, 100097, PR China[c]College of Energy, Xiamen University, Xiamen, Fujian, 361102, PR China) Responses of soil aggregates and bacterial communities to soil-Pb immobilization induced by biofertilizer. Chemosphere,Volume 220 (2019) : 828-836

The objective of this study was to investigate how soil aggregates and bacterial communities responded to soil-lead (Pb) immobilization induced by biofertilizer. Wheat (*Triticum* spp.) was planted in Pb-polluted soil. The re-distribution of Pb in soil aggregates and change of soil microbial communities due to biofertilizers were believed to be responsible for immobilizing

soil Pb and alleviating its phytotoxicity. Adding biofertilizer promoted the formation of large aggregates (0.20–2.0 mm) with more mass loading of Pb, and increased soil bacterial diversity and the abundance of beneficial taxa such as those from the phyla Bacteroidetes, Actinobacteria, and Proteobacteria. In addition, there was significant alleviation of Pb availability as indicated by decreases in the values of bioconcentration factors (BCF) (up to 35.7% and 42.3% for roots and shoots, respectively) of wheat and DTPA-extractable Pb in soil (up to 34.4%) receiving fertilizer treatments compared with the CK (no treatment). Similar bacterial community structures and alpha diversities for the biofertilizer treatments and their autoclaved controls were observed, suggesting that physicochemical properties drove the structure of the soil bacterial community. This study introduced a new idea for development of effective strategies to control or reduce soil Pb risks.

Keywords: Lead; Biofertilizer; Soil aggregate; Bacterial community; Immobilization

MengWang[a], ShanshanLi[b], ShibaoChen[a], NanMeng[a], XiaoyueLi[b], HanZheng[a], ChunmeiZhao[c], DuoWang[d] ([a]Key Laboratory of Plant Nutrition and Fertilizer, Ministry of Agriculture/Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, Beijing 100081, PR China[b]School of Land Science and Technology, China University of Geosciences, Beijing 100083, PR China[c]Guangdong Provincial Key Laboratory of Environmental Pollution Control and Remediation Technology, Sun Yat-sen University, Guangzhou 510275, PR China[d]College of Energy, Xiamen University, Xiamen, Fujian 361102, PR China) **Manipulation of the rhizosphere bacterial community by biofertilizers is associated with mitigation of cadmium phytotoxicity. Science of The Total Environment, Volume 649 (2019) : 413-421**

The objective of this study was to understand the effect of biofertilizers on cadmium (Cd)-induced phytotoxicity and the rhizosphere bacterial community. The crop specie rice (*Oryza sativa* L.) was planted in Cd-contaminated soils, and Illumina high-throughput sequencing was performed to investigate how the composition of the rhizosphere bacterial community responded to the addition of biofertilizers. Biofertilizers were effective in alleviating Cd phytotoxicity as indicated by the significant increase in plant biomass (up to 85.2% and 48.4% for roots and shoots, respectively) and decrease in tissue Cd concentration (up to 72.2% in roots) of rice receiving fertilizer treatments compared with the CK (no treatment). These positive effects were likely due to the increase in soil pH, which can be attributed primarily to Cd immobilization, and the promotion of beneficial taxa such as Proteobacteria, Bacteroidetes, Gemmatimonadetes, and Firmicutes. In addition, autoclaved biofertilizers tended to have similar beneficial effects and similar bacterial community alpha diversities as the original biofertilizer treatments. This suggests that the change in soil physicochemical propertiesby biofertilizer addition might drive the structure of rhizosphere bacterial community, and not the biofertilizer microbes themselves. In both the original and sterilized biofertilizer treatments, the effectiveness in mitigating of Cd phytotoxicity was found to be dependent on the type of biofertilizer applied. Comparatively, the biofertilizer denoted as DY was more effective in mitigating Cd phytotoxicity than others. These results demonstrate that biofertilizer addition could be a promising approach to immobilize soil Cd by manipulating the rhizosphere bacterial community, thus to facilitate plant growth.

Keywords: Cadmium; Biofertilizer; Rhizosphere; Bacterial community; Remediation

I.D.Singhalage[acd], G.Seneviratne[a], H.M.S.P.Madawala[b], P.C.Wijepala[a] ([a]Microbial Biotechnology Unit, National Institute of Fundamental Studies, Kandy, Sri

Lanka[b]Department of Botany, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka[c]Department of Science and Technology, Faculty of Science and Technology, Uva Wellassa University of Sri Lanka, Badulla, Sri Lanka[d]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka) **Profitability of strawberry (*Fragaria ananassa*) production with biofilmed biofertilizer application. Scientia Horticulturae, Volume 243 (2019) : 411-413**

The economic benefits of strawberry production with the application of monocultures of ***Aspergillus*** sp. and ***Enterobactor*** sp. and their mixed cultures (fungal-bacterial biofilm; BF) were calculated in comparison to the recommended dosage of chemical fertilizers (CFs) in a pot experiment. In terms of productivity, strawberry yield with BF coupled with 39% of CFs was 152% profitable over 100% CFs treatment. ***Aspergillus*** sp. and ***Enterobactor*** sp. showed the 102 and 66% of more profits when coupled with 100 and 34% of CFs, respectively. The findings of this study clearly indicate the efficacy of BF as a biofertilizer to reduce the usage of CFs in strawberry cultivation.

Keywords: Strawberry; Productivity; Biofertilizers; Chemical fertilizers

M.Nunes da Silva[a], M.E.Pintado[a], B.Sarmento[bc], N.P.Stamford[d], M.W.Vasconcelos[a] ([a]Universidade Católica Portuguesa, CBQF – Centro de Biotecnologia e Química Fina – Laboratório Associado, Escola Superior de Biotecnologia, Rua Arquiteto Lobão Vital 172, 4200-374 Porto, Portugal[b]I3S-Instituto de Investigação e Inovação em Saúde, Universidade do Porto, Rua Alfredo Allen 208, 4200-135 Porto, Portugal[c]CESPU, Instituto de Investigação e Formação Avançada em Ciências e Tecnologias da Saúde, Rua Central da Gandra 1317, 4585-116 Gandra, Portugal[d]Programa de Pós-graduação em Ciências do Solo, Departamento de Agronomia, Universidade Federal Rural de Pernambuco, Av. Dom Manoel de Medeiros, s/n, Dois Irmãos, Recife, Pernambuco, Brazil) **A biofertilizer with diazotrophic bacteria and a filamentous fungus increases *Pinus pinaster*tolerance to the pinewood nematode (*Bursaphelenchus xylophilus*). Biological Control, Volume 132 (2019) : 72-80**

The pine wilt disease (PWD), caused by the pine wood nematode (PWN) *Bursaphelenchus xylophilus*, is a devastating illness that mainly affects *P. pinaster*trees, and that poses great environmental and economic challenges. Current disease management involves the cut down of infected trees, tree fumigation, use of nematicides, or the control of the insect vector; however, these methodologies are expensive, labour-intensive and have limited success. The aim of this work was to evaluate the effect of a biofertilizer enriched with diazotrophic bacteria and a chitosan-producing fungus, *Cunninghamella elegans*, in inducing *P. pinaster* and *P. pinea* resistance against the PWN. In non-inoculated (control) *P. pinaster* plants, PWN population significantly increased (*ca*. 2.3-fold) throughout the experimental period, whereas in plants treated with 7.5 and 15% of biofertilizer nematode numbers were up to 36.3-fold lower than in control plants. In *P. pinea*, nematode numbers decreased with time for all biofertilizer concentrations tested, and *P. pinea* had up to 27.3-fold lower nematode counts than *P. pinaster*. In addition, the biofertilizer prevented the decrease of photosynthetic pigments and the reduction of water content in infected *P. pinaster* plants. In *P. pinea* the biosynthesis of phenolics increased in PWN-inoculated plants, especially in the presence of the biofertilizer. The addition

of this biofertilizer to soils forested by *P. pinaster*may improve plant defence and could be a potentially simple and inexpensive strategy for the control of the PWD.

Keywords: Biofertilizer; *Cunninghamella elegans;* Pine wilt disease; Pine tree; Phenolics

MengWang[a], ShuhuiDuan[b], ZhichengZhou[b], ShibaoChen[a] ([a]Key Laboratory of Plant Nutrition and Fertilizer, Ministry of Agriculture / Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, Beijing 100081, PR China[b]Hunan Tobacco Science Institute, Changsha 410010, PR China) **Alleviation of cadmium toxicity to tobacco (*Nicotiana tabacum*) by biofertilizers involves the changes of soil aggregates and bacterial communities. Ecotoxicology and Environmental Safety, Volume 169 (2019,) : 240-247**

Tobacco leaves usually accumulate and concentrate high levels of cadmium(Cd) when growing in contaminated soil, and the transfer of Cd through tobacco smoke to human body could cause serious health risks. In this study, we explored the impact of biofertilizers on alleviating Cd-induced growth inhibition of tobacco leaves. Tobacco (*Nicotiana tabacum* L.) was planted in three naturally Cd-polluted soils from Chinese main tobacco-planting areas. Adding biofertilizer alleviated Cd-induced degradation of tobacco leaves quality, represented by the balanced K, Cl, N, nicotine or sugar contents and their ratios; Cd reduction rate of tobacco leaves was increased and soil extractable Cd was decreased, when compared with CK (no extra biofertilizer addition). The following changing tendencies were believed to be responsible for immobilizing soil Cd and alleviating its toxicity to tobacco leaves: the re-distribution of Cd from the fraction of smaller soil aggregates to the fraction of larger soil aggregates; and the shift of major soil microbes by increasing the abundance of beneficial taxa such as those from the phyla Actinobacteria, Proteobacteria or Chloroflexi. In all biofertilizer treatments, the effectiveness in mitigating Cd toxicity to tobacco leaves was dependent on the type of biofertilizer and soil applied. This study provides a feasible way to control or reduce Cd toxicity for sustainable tobacco production.

Keywords: Cadmium; Tobacco; Biofertilizer; Bacterial community; Soil aggregate

Fify AlfyGabra[ab], Mohamed HemidaAbd-Alla[a], Amal W.Danial[a], RefatAbdel-Basset[a], Ahmed M.Abdel-Wahab[a] ([a]Botany and Microbiology Department, Faculty of Science, Assiut University, Assiut, Egypt[b]Molecular Biology Research Unit, Assiut University, Assiut, Egypt). **Production of biofuel from sugarcane molasses by diazotrophic *Bacillus* and recycle of spent bacterial biomass as biofertilizer inoculants for oil crops. Biocatalysis and Agricultural Biotechnology, Volume 19 (2019): 101112**

This study was designed to identify the most potent N_2-fixing and biofuelproducing Bacillus species. Four isolates were selected as the most efficient N_2-fixing organisms which confirmed by *nifH* gene expression. These isolates were identified genetically by 16S rRNA as *Bacillus thuringensis*, Bacillus subtilis, Bacillus pumilus and Bacillus licheniformis. The highest biohydrogen production was 2450 and 2300 ml/L from 6% sugarcane molassesby *B. thuringensis* and *B. subtilis* respectively. Nitrogenase activity of *B. thuringensis* and *B. subtilis* were 1.4 and 1.3 µmol C_2H_4 min^{-1} mg protein $^{-1}$ at 6%

molasses. Ethanol production was 1.55 and 1.03 g/L, while butyric acid was 10.39 and 5.9 g/L at 6% molasses by *B. thuringensis* and *B. subtilis* at 6% molasses, respectively. Acetic acid formation was 1.1 and 0.55, lactic acid was 0.07 and 0.05, while butyric acid was 10.39 and 5.9 g/L at 6% molasses by *B. thuringensis* and *B. subtilis*, respectively. Spent bacterial biomass of the two *Bacillus* species were reused as a biofertilizer for enhancing the growth of sunflower and corn plants. Inoculation of sunflower and corn seeds with *B thuringensis* and *B subtilis* significantly increased dry weight, total protein, total carbohydrates and pigment contents over control plants. This enhancement could be attributed to the efficiency of biological N_2-fixation due to nitrogenase activity of the tested *Bacillus* species. These results suggest that the possibility of interlinking biofuel technology with biofertilizer production by reusing N_2-fixing spent bacterial biomass of *Bacillus* could be increase the economic feasibility of the bioenergy production from molasses.

Keywords: *Bacillus;* Biohydrogen; Biofuel; Bioethanol; Biofertilizer; Molasses

Shakeel A.Khan[a], Gulshan K.Sharma[ab], Fayaz A.Malla[ac], AmitKumar[d], Rashmi[e], NavinduGupta[a] ([a]Division of Environmental Sciences, Centre for Environmental Science and Climate Resilient Agriculture, ICAR- Indian Agricultural Research Institute, Pusa, New Delhi, 110012, India[b]National Bureau of Soil Survey and Land Use Planning, Regional Centre Jorhat, Assam, India[c]Environmental Sciences, Higher Education Department, Govt. of Jammu & Kashmir, Govt. Degree College Baghi Dilawar Khan Srinagar, 190002, India[d]Department of Botany, Dayalbagh Education Institute, Agra, Uttar Pradesh, India[e]CSIR-RAB, Library Avenue, Pusa Complex, New Delhi, India) **Microalgae based biofertilizers: A biorefinery approach to phycoremediate wastewater and harvest biodiesel and manure. Journal of Cleaner Production,Volume 211 (2019) : 1412-1419**

The most important requirement of the agrarian advancement is resilient nutrient source for agriculture without jeopardizing the environmental assets and economy of the country. An algal biorefinery approach is the prime requirement for the sustainable production of biodiesel and biofertilizersafter remediation of wastewater. In the present study, the microalgae *Chlorella*minutissima, Scendesmus spp and *Nostoc* muscorum and their consortium were used for the biorefinery approach. *C. minutissima* has shown maximum phycoremediation potential when compared to other possible microalga and their consortium. Experimental results showed that removal of NH_4^+-N, NO_3^--N, PO_4^{-3}-P, TDS, BOD_5 and COD were found to be 92, 87, 85, 96, 90 and 81% respectively. The maximum dry biomass was observed in *C. minutissima*followed by *Scendesmus spp,* and *N. muscorum,* i.e., 0.45 ± 0.01 g L^{-1}, 0.44 ± 0.02 g L^{-1}, 0.14 ± 0.03 g L^{-1} respectively. The nutrient fraction of nitrogenand phosphorus were maximum in *C. minutissima*, i.e., 5.46 ± 0.27 and 0.85 ± 0.03 respectively. The lipid productivity recorded maximum in *Scendesmus* (81.23 ± 4.5 mg L^{-1}) followed by *N. muscorum* (14.29 ± 8.7 mg L^{-1}) and *C. minutissima* (11.33 ± 5.6 mg L^{-1}). Using this biomass as manure one can save the chemical fertilizer of worth about 5584 $ (US Dollar) ha^{-1} yr^{-1}. The present study not only supports the sustainable phytoremediation, biodiesel production, and organic manure utilization directly but indirectly to combat climate change scenario through minimizing greenhouse gases production.

Keywords: Phycoremediation; Wastewater; Biorefinery; *Chlorella;* Biodiesel; Biofertilizers

Maria LuizaVeroneze[a], DanielSchwantes[b], Affonso CelsoGonçalvesJr.[c], AlfredoRichart[d], JéssicaManfrin[b]Andréiada Paz Schiller[b]Thiago BanaSchuba[a] ([a]State University of Western Paraná, Postgraduate Program in Energy Engineering in Agriculture, Campus of Cascavel, Universitária Street, 2069, Jardim Universitário, Cascavel, Paraná State, 85819-110, Brazil[b]Educational College of Medianeira, 1820 Rio Branco Street, Downtown, Medianeira, State of Paraná, 85884-000, Brazil[c]State University of Western Paraná, Postgraduate Program in Agronomy, Campus of Marechal Cândido Rondon, Pernambuco Street, 1777, Centro, Marechal Cândido Rondon, Paraná State, 85960-000, Brazil[d]Pontifical Catholic University of Paraná, Agronomy, Campus of Toledo, Union Avenue, 400, Jardim Coopagro, Toledo, Parana State, 85902-532, Brazil) **Production of biogas and biofertilizer using anaerobic reactors with swine manure and glycerin doses. Journal of Cleaner Production, Volume 213 (2019) : 176-184**

This research aims to evaluate the development of biodigestion of swinemanure with addition of glycerin doses, in order to promote a cleanerdestination for both of these wastes in agroindustry, adopting different concentrations for a better relation of biogas production and biostabilized fertilizer. For this, five anaerobic biodigestors were developed, each reactorwas fed with swine manure considering four treatments (5%, 10%, 15% and 20% vv^{-1} of glycerin). The physical-chemical parameters (temperature, pH, turbidity, solids series, total phosphorus, total nitrogen (Kjeldahl), and COD were evaluated every seven days, moreover the biogas production was monitored daily by a gasometer. The concentrations of Cu, Zn, Mn, Fe, Cd, Pb and Cr during hydraulic retention time (HRT) were determined by Flame Atomic Absorption Spectrometry (FAAS). Anaerobic co-digestion of swine and glycerin wastes didn't provided higher biogas production than the biodigestion without the addition of glycerin. The biogas production rates were impaired by the addition of glycerin doses higher than 5%, and the results demonstrate that the nutrient concentrations in the biostabilized waste are expressive for vegetal biofertilization, mainly for N, P, K, Ca, Mg and micronutrients such as Cu and Zn.

Keywords: Renewable energy; Biofuel; Glycerin; Co-digestion; Biogas production

Biocomposting

Jairo Alexander Lozano-Moreno[a] FrançoisMaréchal[b] ([a]Grupo de Investigación en Competitividad y Productividad Empresarial (GICPE), Universidad Autónoma de Occidente, Km 2 vía Jamundí, Cali, Colombia[b]Industrial Process and Energy Systems Engineering Group (IPESE), École Polytechnique Fédérale de Lausanne, Rue de l'Industrie 17, Case Postale 440 CH-1951 Sion, Switzerland) **Biomass logistics and environmental impact modelling for sugar-ethanol production. Journal of Cleaner Production, Volume 210 (2019) :317-324**

The goal of this paper is to evaluate the supply of sugarcane to mills and also the supply of green harvesting residues to second-generation ethanol plants under three different strategies: chopping, baling and integral harvesting. A dynamic model was developed in order to simulate the biomass flow along the main activities within sugar-ethanol supply chain. Weather,

geographical and operational constraints were considered for calculating the biomassavailability. The model is able to quantify the production of sugar and first-generation ethanol from mills, electricity surplus from co-generation and second-generation ethanol with the aim of evaluating operational, economicand environmental indicators. In this study it was found that the integral harvesting is the best strategy for supply the residues in terms of cost (5.90 USD/dry t), energy inputs (56.89 MJ/dry t) and carbon emissions (4.18 kg CO_2/dry t). The low resources utilization due to the inappropriate harvest-load-transport synchronization creates bottlenecks that decrease the system throughput, leaving the door open for further improvements.

Keywords: Biomass logistics; Sugarcane residues; Environmental impact; Waste-to-energy; Bioenergy

QinghongSun[ab], JianChen[c], YuquanWei[d], YueZhao[a], ZiminWei[a], Haiyang Zhang[e], Xintong Gao[a], JunqiuWu[a], XinyuXie[a] ([a]College of Life Science, Northeast Agricultural University, Harbin 150030, China[b]School of Resources and Environment Science, Wuhan University, Wuhan 430079, China[c]Beijing Tongzhou Agriculture Products Quality Inspection & Testing Center, Beijing 101149, China[d]School of Environment and State Key Joint Laboratory of Environment Simulation and Pollution Control, Tsinghua University, Beijing 100084, China[e]College of Veterinary Medicine, Northeast Agricultural University, Harbin 150030, China) **Effect of semi-continuous replacements of compost materials after inoculation on the performance of heat preservation of low temperature composting. Bioresource Technology, Volume 279 (2019) : 50-56**

Development of cold-adapted microbial agent is an efficient approach for composting in low temperature. The study was conducted to evaluate the effect of semi-continuous replacements of compost materials after inoculation (SRMI) on the heat preservation of low temperature composting derived from chicken manure. Results revealed that SRMI could significantly improve the heat preservation of the pile, although the time of start-up in two inoculation groups was approximately the same. Due to the increase in the number of replacements of materials led to the changes in microbial community structures and enzyme activity. Non-metric multidimensional and colorimetric methods indicated that microbial community structures and enzyme activity was completely different in SRMI. Structural equation model was constructed by key factors involved in diversity of the microbial community, enzyme activity, temperature and bio-heat generation. In summary, SRMI decidedly increase the heat preservation time of the pile and start-up efficiency of the low temperature composting.

Keywords: Semi-continuous replacements of compost materials after inoculation; Low temperature composting; Bio-heat generation; Heat preservation;Structural equation model

R.Spaccini[ab], V.Cozzolino[ab], V.Di Meo[b], D.Savy[a], M.Drosos[a], A.Piccolo[ab] ([a]CERMANU Interdepartmental Research Centre, Università di Napoli Federico II, Via Università 100, 80055 Portici, Italy[b]Department of Agricultural Sciences, Università di Napoli Federico II, Via Università 100, 80055 Portici, Italy) **Bioactivity of humic substances and water extracts from compost made by ligno-cellulose wastes from biorefinery. Science of The Total Environment,Volume 646 (2019) :792-800**

The ligno-cellulose residues from biorefinery production of bio-ethanol were used as woody structuring material within an on-farm composting system, with the aim to obtain bioactive water soluble and humic fractions from composted materials. The molecular characterization of initial biomasses and final products revealed a transformation towards more stable compounds during composting and showed the selective incorporation of specific phenolic derivatives of ligno-cellulose in both bulk samples and corresponding extracts. While the use of the stable bulk composts as organic fertilizer resulted in a decrease of nitrogen and phosphorous assimilation in maize tissues, a bio-stimulation was shown by water soluble organic compounds and humic substances in germination tests and pot experiments, respectively. The differential responses obtained in maize seedlings and plants were related to the molecular composition and concentration of the applied water extracts and humic substances, thus suggesting a role of phenols and lignin derivatives in the stimulation of maize roots and shoots and the enhancement of P uptake. The results confirm that ligno-cellulose residues may be effectively recycled as composting additives in order to enrich mature compost in aromatic and lignin compounds. A preliminary knowledge on the molecular characteristics and biological properties of composted materials is an essential requirement to select the most suitable derivatives from composted ligno-cellulose wastes in sustainable agricultural practices.

Keywords: Ligno-cellulose residues; On-farm composting; Molecular characterization; Humic substances; Water extracts; Maize bio-stimulation

Hong-taoLiu[a], Xiao-xiaGuo[ab] ([a]Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing 100101, China[b]College of Resource and Environment, University of Chinese Academy of Sciences, Beijing 100049, China) **Hydroxyapatite reduces potential Cadmium risk by amendment of sludge compost to turf-grass grown soil in a consecutive two-year study. Science of The Total Environment,Volume 661 (2019) :48-54**

Recycling of sludge compost to soil as conditioner is generally regarded as the best means of disposal. However, concerns regarding heavy metal residues and sludge toxicity have recently received increasing public attention. Cadmium (Cd) is a mobile metal commonly found in sludge; therefore, the risk posed by Cd contaminated sludge should be carefully assessed. In this report, the effects of addition of hydroxyapatite (HAP) with sludge compost amendment on potential Cd risk were investigated. The results of consecutive two years showed that exchangeable Cd content in treatment of sludge compost with 1.5% HAP decreased by 6.0% compared with single sludge compost treatment, and residual Cd increased by 7.6%. Compared with single sludge compost, the incremental rate of exchangeable Cd dropped by 38.3% and the reductive rate of residual Cd increased by 37.7% in response to 1.5% HAP addition, indicating that HAP played a role of decreasing Cd phytoavailability. The HAP reduced the amount of Cd uptaken by turf-grass in both root and leaf. Moreover, HAP remarkably improved the quality of turf grass grown in amended soil, including leaf greenness, green maintainable period and root strength. However, HAP did not attenuate the downward mobility of Cd. Taken these together, these findings indicated that HAP can be used as a potential candidate to control surface Cd risk of sludge compost amended soil rather than that from leachate.

Keywords: Organic waste; Deactivator; Heavy metal; Soil application

HonghongGuo[a], JieGu[ab], XiaojuanWang[a], XiaxiaTuo[a], JingYu[a], RanranZhang[a] ([a]College of Natural Resources and Environment, Northwest A&F University, Yangling, Shaanxi

712100, China[b]Research Center of Recycle Agricultural Engineering and Technology of Shaanxi Province, Northwest A&F University, Yangling, Shaanxi 712100, China) Key role of cyromazine in the distribution of antibiotic resistance genes and bacterial community variation in aerobic composting. Bioresource Technology, Volume 274 (2019) : 418-424

The risks that have not been noted so far have come from the use of non-antibiotics. In this study, non-antibiotic drug (cyromazine) was used in composting to investigate its possible effects on the distribution of ARGs and changes of bacterial community. Results showed that cyromazine increased the abundances of highly-risky ARGs ($bla_{CTX\text{-}M}$ and bla_{VIM}), and heavy metal resistance genes (MRGs). Low and high concentrations of cyromazine increased the abundance of *Tn916/1545* by 18.27% and 64.26%, respectively, compared with the control treatment. Mobile genetic elements (MGEs) and MRGs were not the major cause of the dynamic changes in ARGs, but instead the bacterial community succession changed according to the moisture content, pH, and bio-Cu. Network analysis showed that Proteobacteria and Actinobacteria were the major hosts for ARGs, and there was a significant correlation between *tcrB*, *sul1* and *Tn916/1545*.

Keywords: Antibiotic resistance gene; Composting; Cyromazine; Bacterial community composition

HonghongGuo[a], JieGu[ab], XiaojuanWang[a], JingYu[a], MubasherNasir[a], HuilingPeng[a], RanranZhang[a], TingHu[a], QianzhiWang[a], JiyueMa[a] ([a]College of Natural Resources and Environment, Northwest A&F University, Yangling, Shaanxi, 712100, China[b]Research Center of Recycle Agricultural Engineering and Technology of Shaanxi Province, Northwest A&F University, Yangling, Shaanxi, 712100, China) Responses of antibiotic and heavy metal resistance genes to bamboo charcoal and bamboo vinegar during aerobic composting. Environmental Pollution, 2019

The application of compost in agriculture has led to the accumulation of antibiotic resistance genes (ARGs) and heavy metal resistance genes (MRGs) in the soil environment. In this study, the response of ARGs and MRGs to bamboo charcoal (BC) and bamboo vinegar (BV) during aerobic composting was investigated. Results showed that BC + BV treatment reduced the abundances of ARGs and mobile genetic elements (MGEs) during the thermophilic period, as well as achieved the lowest rebound during the cooling period. BC + BV promoted the growth of Firmicutes, thereby facilitating the thermophilic period of composting. The rebound of ARGs and MGEs can be explained by increasing the abundance of Actinobacteria and Proteobacteria at the end of composting. Composting reduced the abundances of MRGs comprising *pcoA*, *tcrB*, and *cueO*, whereas *cusA* and *copA* indicated the selective pressure imposed by heavy metals on bacteria. The fate of ARGs was mainly driven by MGEs, and heavy metals explained most of the variation in MRGs. Interestingly, nitrogen conversion also had an important effect on ARG and MRG profiles. Our current findings suggest that the addition of BC + BV during compost preparation is an effective method in controlling the mobility of ARGs and MRGs, thereby reducing the environmental problems.

Keywords: Antibiotic resistance gene; Bamboo charcoal; Bamboo vinegar; Composting; Heavy metal resistance gene

Biopesticide

P.Rodríguez A.Cerda X.Font A.Sánchez A.Artola. (Composting Research Group, Department of Chemical, Biological and Environmental Engineering, Escola d'Enginyeria, Universitat Autònoma de Barcelona, Cerdanyola del Vallès, 08193 Barcelona, Spain)
Valorisation of biowaste digestate through solid state fermentation to produce biopesticides from *Bacillus thuringiensis.* Waste Management, Volume 93 (2019) : 63-71

The main goal of this work is the production of a biopesticide through solid-state fermentation of biowaste digestate inoculated with ***Bacillus thuringiensis***(Bt) at pilot scale using different configurations of reactors. Fermentations were carried out using insulated and non-insulated, stirred and non-stirred reactors at different scales (10, 22 and 100 L) in order to assess the influence of the reactor configuration on the biopesticide production process. A maximum temperature of 60 °C was reached in 10-L insulated non-stirred reactors where increments of Bt viable cells and spores with respect to initial values of 1.9 and 171.6 respectively, were attained. In contrast, when temperature was regulated by using 22-L non-insulated stirred reactors the increment of viable cells and spores were 0.8 and 1.9, respectively, at a stable temperature of 27 °C. When the non-insulated stirred reactor was scaled up to 100-L, the increase of viable cells and spore counts were 1.2 and 3.8 respectively, with an average temperature of 28 °C. These results demonstrated that the election of a proper reactor configuration is important when considering the development of a new SSF process, especially when dealing with non-conventional substrates as digestate.

Keywords: *Bacillus thuringiensis;* Digestate; Biopesticides; Solid-state fermentation; Pilot scale

M[a] RosaPino-Otín[a], DiegoBallestero[a], EnriqueNavarro[b], AzucenaGonzález-Coloma[c], JonatanVal[a], Ana M.Mainar[d] ([a]Universidad San Jorge, Villanueva de Gállego, 50830 Zaragoza, Spain[b]Instituto Pirenaico de Ecología, CSIC, Av. Montañana 1005, 50059 Zaragoza, Spain[c]Instituto de Ciencias Agrarias, CSIC, Serrano 115-dpdo, 28006 Madrid, Spain[d]I3A, Universidad de Zaragoza, c/ Mariano Esquillor s/n, 50018 Zaragoza, Spain)
Ecotoxicity of a novel biopesticide from Artemisia absinthium on non-target aquatic organisms. Chemosphere, Volume 216 (2019) : 131-146

Biopesticides are increasingly being used to replace synthetic pesticides for pest control. This change raises concern for its environmental impacts, especially on non-target organisms. In this study, the ecotoxicological effects of a potential nematicide from Spanish populations of *Artemisia absinthium*(var. Candial) were evaluated on freshwater and aquatic non-target organisms. The study focused on the aqueous extract (hydrolate), the principal component of which ((−) -(Z) −2,6-dimethylocta-5,7-diene-2,3-diol) is responsible for its nematicidal effect. Until now, the hydrolate has been considered a byproduct of the process used to obtain essential oils, and there are no studies on its ecotoxicity from any plant with biopesticide properties. Our results indicated that *A. absinthium* hydrolate caused acute toxicity for non-target organisms at dilutions as low as 0.2%. The sensitivity of the organisms, from the most to the least sensitive, was: *Daphnia magna*(LC_{50} = 0,236%) > *Vibrio fisheri* (LC_{50} = 1,85%) > *Chlamydomonas reinhardtii*(LC_{50} = 16,49). Moreover, the *A. absinthium* organic extract was highly toxic to *D. magna* (LC_{50} = 0,093 mg/L). *A. absinthium* hydrolate toxicity was also tested on a natural river microbial community. Bacterial growth was not affected; the physiology of the community was only slightly modified, namely through an increased ability to degrade different

substrates, mainly carbohydrates. This study provides for the first time an exhaustive assessment of the environmental exposure of a plant-derived biopesticide and shows that these products may cause a broad range of toxicity on non-target aquatic organisms.

Keywords: Biopesticide; *Artemisia absinthium;* Ecotoxicity; Hydrolate

TaoMa[ab], HuifangWang[a], ShipingLiang[a], QiangXiao[c], PanrongCao[d], XuanChen[e], YingNiu[f], YurongHe[b], ZhaohuiSun[a], XiujunWen[a], CaiWang[a] ([a]Guangdong Key Laboratory for Innovation Development and Utilization of Forest Plant Germplasm, College of Forestry and Landscape Architecture, South China Agricultural University, Guangzhou 510642, China[b]College of Agriculture, South China Agricultural University, Guangzhou 510642, China[c]Chinese Academy of Agricultural Sciences, Tea Research Institute, Hangzhou 310008, China[d]College of Horticulture, South China Agricultural University, Guangzhou 510642, China[e]Department of Biology, Salisbury University, Salisbury, MD 21801, USA[f]Chongqing Academy of Agricultural Sciences, Chongqing 400020, China) **Effects of soil-treatment with fungal biopesticides on pupation behaviors, emergence success and fitness of tea geometrid, *Ectropis grisescens* (Lepidoptera: Geometridae). Journal of Asia-Pacific Entomology, Volume 22, Issue 1, March 2019, Pages 208-214**

Ectropisgrisescens Warren (Lepidoptera: Geometridae) is one of the most severe defoliating pests of tea plants. Synthetic pesticides have been widely applied to control this pest in tea plantations, but pesticide residues may decrease the quality and safety of tea products. In the present study, we hypothesized that soil treatment with the two commercial biopesticides (Shuiguxin®) based on *Metarhizium anisopliae* (Metchnikoff) Sorokin and *Beauveria bassiana* (Balsamo) could reduce the survivorship and fitness of *E. grisescens*. Wandering larvae of *E. grisescens* were allowed to pupate in soil treated with each biopesticide, and the concentrations of *M. anisopliae* (Shuiguxin®) and *B. bassiana* (Shuiguxin®) that produced the 50% mortality values (LC_{50}) were 2.9×10^6 and 1.6×10^7 conidia/g soil, respectively. Artificial burying the pupae using soil treated with *M. anisopliae* (Shuiguxin®) and *B. bassiana* (Shuiguxin®) (1×10^8 or 1×10^9 conidia/g soil for both biopesticides) also significantly reduced emergence success of *E. grisescens*. In addition, choice tests showed that soil treated with the high concentration of *M. anisopliae* (Shuiguxin®) or *B. bassiana*(Shuiguxin®) had repellent effects on pupating *E. grisescens*. However, sublethal concentrations (LC_{25} and LC_{50}) of both biopesticides did not significantly affect fecundity, fertility and longevity of post-emerged adults. Our study showed that soil treatment with the two commercial biopesticides caused direct mortality of pupating *E. grisescens*, but may not effectively suppress *E. grisescens* populations at sublethal concentrations. The realistic application of the fungal dosage in fields should be determined in future studies.

Keywords: *Ectropis grisescens;* Biopesticide; Entomopathogenic fungus; Soil-pupating pest;*Camellia sinensis*

Wei DAIYao LIJun ZHULin-quan GEGuo-qing YANG Fang LIU (College of Horticulture and Plant Protection, Yangzhou University, Yangzhou 225009, P.R.China) **Selectivity and sublethal effects of some frequently-used biopesticides on the predator *Cyrtorhinus***

***lividipennis* Reuter (Hemiptera: Miridae). Journal of Integrative Agriculture, Volume 18, Issue 1 (2019) : 124-133**

The green miridbug, *Cyrtorhinus lividipennis,* is an important predator of the rice brown planthopper, *Nilaparvata lugens.* In this study, the selective toxicity of seven commercial biopesticides for *C. lividipennis* was examined under laboratory conditions; abamectin was the most selective to *C. lividipennis,*followed by matrine and azadirachtin. Veratridine, rotenone, *Bacillus thuringiensis* and *Beauveria bassiana* showed less selectivity for *C. lividipennis.*Subsequently, matrine, abamectin and azadirachtin were selected for sublethal assessments with respect to *C. lividipennis* due to their high toxicities to *N. lugens. C. lividipennis* treated with sublethal concentrations (LC_{10} and LC_{20}) of the three biopesticides could distinguish volatiles released from healthy and *N. lugens*-infested plants indicating that the biopesticides tested did not affect the foraging ability of surviving miridbugs. Azadirachtin decreased the consumption capability of *C. lividipennis* when the densities of *N. lugens* were 20, 30, 40 and 50 insects per vial. Sublethal concentration treatment did not impact the pre-oviposition period or egg hatchability of *C. lividipennis.*However, the fecundity of *C. lividipennis* exposed to azadirachtin and abamectin increased by 27–41% compared to the untreated individuals. In summary, abamectin or matrine together with *C. lividipennis* could be considered an effective, sustainable pest management strategy for rice.

Keywords: Biopesticides; *Cyrtorhinus lividipennis;* selective toxicity; sublethal effects

Jong Cheol KimMi Rong LeeSihyeon KimSe JinLeeSo EunParkSehyeonBaekLeilaGasmiTae YoungShinJae SuKim. (Department of Agricultural Biology, College of Agriculture & Life Sciences, Chonbuk National University, Republic of Korea) Long-term storage stability of *Beauveria bassiana* ERL836 granules as fungal biopesticide. Journal of Asia-Pacific Entomology, Volume 22(2) (2019) : 537-542

Beauveria bassiana (Balsamo) Vuillemin (Hypocreales: Cordycipitaceae) ERL836 has been commercialized under the name ChongchaeSak to control an agricultural insect pest, the western flower thrips *Frankliniella occidentalis*Pergande (Thysanoptera: Thripidae), in the Republic of Korea. As soon as it was launched in 2017, it became a popular product and has received a positive response. However, study of the storage stability of the fungus ERL836 has yet to be investigated. To determine the optimum conditions for long-term storage, we assessed conidial viability and insecticidal activity of *B. bassiana*ERL836 according to storage temperature and culture substrate. Viability of *B. bassiana* ERL836 conidia from mycotized grains (millet and rice) stored at low (4 °C) and moderate (25 and 30 °C) temperatures was maintained at >85% for 24 and 18 months, respectively, along with insecticidal activity. In contrast, the samples stored at 37 °C showed low germination rate (about 80% germination rate for only 5 months). This result suggests that low and moderate temperatures (4 to 30 °C) conserve *B. bassiana* ERL836 viability and virulence.

Keywords: Fungal biopesticide; Conidial germination; Insecticidal activity; Shelf-life;Mycotized grain

I.E.Sharapova. (Institute of Biology, Komi Science Centre, Ural Division, Russian Academy of Sciences, Syktyvkar, 167982, Russian Federation) Prospects of using entomopathogenic fungus in development of a biopesticide product with nematicidal activity. Biocatalysis and Agricultural Biotechnology, Volume 19 (2019)

Entomopathogenic and nematophagous fungi are the recourse for biologicalcontrol of phytoparasitic insects or various stages of nematodes. The objective of this work was to evaluate the prospects of using an entomopathogenic fungus strain of Beauveria bassiana to develop a biological product, in native form and immobilized on a carrier, which would possess, among other characteristics, nematicide activity. In culture suspension based on a mixtureof milk whey and brewing spent grain liquor, the product showed catalase and cellulolytic activity, as well as high yield of spore-bearing biomass. Insecticidal activity of the fungus has been determined relative to a test-organism - Drosophila melanogaster. Virulence was at 50% with the infective dose of 10^2 CFU. A method of fungus passaging through organism of an insect is proposed as a way of maintaining biological activity. We have found nematocidal activity of the strain of *B.bassiana* with regard to a test organism – bacterial-feeding nematodes of the Rhabditidae family. A correlationdependency has been revealed between biological activity in terms of motile stages of nematodes and the concentration of culture suspension containing enzymes, secondary metabolites and native (own) toxins of entomopathogenic fungus. Use of native, undiluted suspension based on the mixture of milkwhey and brewing spent grain liquor ensured 100% death of the number of nematodes within 2 day of incubation. The suggested product is a biodegradable carrier-immobilized form of biopesticide developed using spent grain that ensured viability of infectious units of the strain after storage.

Keywords: Biological pest control; Nematodes; *Beauveria bassiana* strain; Enzymes; Whey; Brewery spent grain and spent grain liquor

Noor HafizahRamli[a], SuzanaYusup[a], Armando T.Quitain[b], KhairiraihanaJohari[a], Benjamin Wei BinKueh[a] ([a]Chemical Engineering Department, Biomass Cluster Centre of Biofuel and Biochemical Research, Institute of Sustainable Living, Universiti Teknologi PETRONAS, 32610 Seri Iskandar, Perak Darul Ridzuan, Malaysia[b]Department of Applied Chemistry and Biochemistry, Faculty of Advanced Science and Technology, Kumamoto University, 2-39-1 Kurokami, Chuo-ku, Kumamoto 860-8555, Japan) **Optimization of saponin extracts using microwave-assisted extraction as a sustainable biopesticide to reduce *Pomacea canaliculata*population in paddy cultivation. Sustainable Chemistry and Pharmacy, Volume 11 (2019) : 23-35**

This study highlights the optimum conditions to extract saponins from *Furcraea* selloa var. marginata (*Furcraea* leaves) and spent tea leaves (STL) using supercritical-CO_2 ($ScCO_2$) and microwave. The bioactivity effects of saponins towards golden apple snails, *Pomacea canaliculata* were shown. The experiment was designed using the response surface methodology (RSM) to determine the optimum conditions for both extractions technique. Based on RSM analysis, the highest yield of saponins was obtained at 21.60 MPa, 0.30 mm particle size and 4.62 ml/min CO_2 for 30 min using $ScCO_2$ extraction. Meanwhile, in microwave-assisted extraction (MAE), the highest yield obtained was at 90 °C, 9 min of extraction time and 23.54 ml solvent per gram of sample. The effect of solvent was also investigated. Using water as

co-solvent in $ScCO_2$ extraction and as solvent in MAE resulted in better yield of saponins. Overall, MAE was more efficient to extract saponins with 3.43 wt% compared to $ScCO_2$extraction with only 0.49 wt%. The efficacy test of synthesized biopesticidesagainst golden apple snails (GAS) proved that *Furcraea* leaves extract is the active ingredient to produce effective biopesticide as its performance was able to increase the mortality of GAS up to 100% within 24 h observation and enhanced the paddy growth at early stage of cultivation.

Keywords: Saponins; Supercritical-CO_2 extraction; Microwave-assisted extraction; Golden apple snails

ViennaDelnat[a1], Tam T.Tran[ab1], LizanneJanssens[a], RobbyStoks[a] ([a]Laboratory of Evolutionary Stress Ecology and Ecotoxicology, University of Leuven, Belgium[b]Department of Aquatic Animal Health, Institute of Aquaculture, Nha Trang University, Nha Trang, Viet Nam) **Daily temperature variation magnifies the toxicity of a mixture consisting of a chemical pesticide and a biopesticide in a vector mosquito. Science of The Total Environment, Volume 659 (2019) : 33-40**

While many studies on the toxicity of pesticides looked at the effects of a higher mean temperature, effects of the realistic scenario of daily temperature variation are understudied. Moreover, despite the increasing interest for the toxicity of pesticide mixtures how this is influenced by temperature has been largely ignored. We tested whether daily temperature variation (DTV) magnifies the toxicity of two pesticides with a different mode of action, the organophosphate pesticide chlorpyrifos (CPF) and the biopesticide *Bacillus*thuringiensis var. *israelensis* (Bti), and of their mixture in the vector mosquito*Culex pipiens*. Single exposure to CPF and Bti increased mortality and reduced female development time, and exposure to CPF also increased female wing length. DTV was not lethal and did not change the toxicity of the individual pesticides. Yet, a key novel finding was that high DTV increased the mortality of the mixture by changing the interaction between both pesticides from additive to synergistic. Given that in nature daily temperature variation is omnipresent, this is important both for vector control and for ecological risk assessment. The higher toxicity of the mixture at high DTV compared to the typically used constant test temperatures in the laboratory urges caution when evaluating the environmental impact of pesticide mixtures.

Keywords: Antagonism; Climate change; Global warming; Interaction effect; Synergism; Integrated vector management

AlejandraCerda[a], LauraMejias[ab], PaulaRodríguez[a], AlejandraRodríguez[a], AdrianaArtola[a], XavierFont[a], TeresaGea[a], AntoniSánchez[a] ([a]GICOM Research Group, Department of Chemical, Biological and Environmental Engineering, School of Engineering, Edifici Q, Universitat Autònoma de Barcelona, 08193 Bellaterra, Barcelona, Spain[b]Aeris Tecnologías Ambientales S.L., Carrer Santa Rosa, 38, local, 08290 Cerdanyola del Vallès, Barcelona, Spain) **Valorisation of digestate from biowaste through solid-state fermentation to obtain value added bioproducts: A first approach. Bioresource Technology, Volume 271, (2019) : 409-416**

Digestate from biowaste was assessed as a potential source of bioproducts of commercial and industrial interest through solid-state fermentation. The targeted bioproducts were hydrolytic enzymes (cellulases and proteases from autochthonous microbiome), biosurfactants (sophorolipids produced from *Starmella bombicola*) and biopesticides (produced

from Bacillus thuringiensis). Low cellulase production was observed within the range of 0.5–1.5 FPU g^{-1} DM while protease production showed two discrete peaks of 66 ± 8 and 65 ± 3 U g^{-1}DM at 3.5 and 48 h, respectively. Low sophorolipids production was also obtained, with a maximum yield of 0.02 g g^{-1} DM using hygienised digestate supplemented with external sugar and fat sources. Biopesticides produced by *B. thuringiensis* were successfully at 72 h of operation, reaching a maximum spore production of 8.15 ± 0.04 (10^7) CFU g^{-1} DM and 2.85 ± 0.22 (10^7) CFU g^{-1}DM using sterile and hygienised digestate, respectively. These biopesticides could contribute to the substitution of chemically produced pesticides, moving towards a sustainable digestate management in a circular economy scheme.

Keywords: Solid state fermentation; Digestate; Valorisation; Bioproducts; Biopesticide

Biodegradation

AikateriniPapazi, MariaKaramanli, KiriakosKotzabasis (Department of Biology, University of Crete, Voutes University Campus, GR-70013 Heraklion, Greece) **Comparative biodegradation of all chlorinated phenols by the microalga *Scenedesmus obliquus*— The biodegradation strategy of microalgae. Journal of Biotechnology,Volume 296 (2019) : 61-68**

This work presents the comparative biodegradation of all chlorinated phenolic compounds by the green alga *Scenedesmus obliquus* and determines the microalgal bioenergetic strategy. The microalga manages its energyreserves rationally by investing them, either on growth or on the biodegradation of the toxic compound. The microalga seems to follow two distinct detoxification strategies. In the first one, when microalgae are surrounded by relatively low toxic phenolic compounds (phenol, monochlorophenols, 2,4-dichlorophenol and 2,6-dichlorophenol), they use all, or at least more of their energy reserves to increase the biomass production and not the biodegradation. In the second one, when surrounded by higher toxic chlorophenols (*meta*-substituted dichlorophenols, trichlorophenols, tetrachlorophenols and pentachlorophenol) the microalgae invest more, or all of their energy reserves directly in the biodegradation of the toxic compounds, while less or no energy is invested in biomass increase. The microalga biodegraded in five days approximately 9% of the lower toxic phenol and 90% of the higher toxic pentachlorophenol. Considering our ability to interfere with microalgae energy reserves, which define their stress tolerance in the toxic environment, and knowing the microalgal bioenergetic strategy, we could easily use microalgae to biodegrade toxic wastes in the frame of a rational biotechnological approach in the near future.

Keywords: Biodegradation; Bioenergetics; Chlorophenols; Microalgae; Toxicity

KishorAcharya[a], DavidWerner[a], JanDolfing[a], MaciejBarycki[b], PaolaMeynet[a], WojciechMrozik[a], OladapoKomolafe[a], TomaszPuzyn[b], Russell J.Davenport[a] ([a]School of Engineering, Cassie Building, Newcastle University, Newcastle Upon Tyne, NE1 7RU, United Kingdom[b]Laboratory of Environmental Chemometrics, Faculty of Chemistry, University of Gdańsk, Wita Stwosza 63, 80-308, Gdańsk, Poland) **A quantitative structure-**

biodegradation relationship (QSBR) approach to predict biodegradation rates of aromatic chemicals. Water Research, Volume 157 (2019) : 181-190

The objective of this work was to develop a QSBR model for the prioritizationof organic pollutants based on biodegradation rates from a database containing globally harmonized biodegradation tests using relevant molecular descriptors. To do this, we first categorized the chemicals into three groups (Group 1: simple aromatic chemicals with a single ring, Group 2: aromatic chemicals with multiple rings and Group3: Group 1 plus Group 2) based on molecular descriptors, estimated the first order biodegradation rate of the chemicals using rating values derived from the BIOWIN3 model, and finally developed, validated and defined the applicability domain of models for each group using a multiple linear regression approach. All the developed QSBR models complied with OECD principles for QSAR validation. The biodegradation rate in the models for the two groups (Group 2 and 3 chemicals) are associated with abstract molecular descriptors that provide little relevant practical information towards understanding the relationship between chemical structure and biodegradation rates. However, molecular descriptors associated with the QSBR model for Group 1 chemicals ($R^2 = 0.89$, $Q^2_{loo} = 0.87$) provided information on properties that can readily be scrutinised and interpreted in relation to biodegradation processes. In combination, these results lead to the conclusion that QSBRs can be an alternative tool to estimate the persistence of chemicals, some of which can provide further insights into those factors affecting biodegradation.

Keywords: Biodegradation rates; Molecular descriptors; QSBR; Quantitative structure activity relationships

RosaPosada-Baquero[a], MagdalenaGrifoll[b], José-JulioOrtega-Calvo[a] ([a]Instituto de Recursos Naturales y Agrobiología de Sevilla (IRNAS), C.S.I.C., Avenida Reina Mercedes, 10, E-41012 Seville, Spain[b]Univ Barcelona, Fac Biol, Dept Genet Microbiol & Stat, Diagonal 643, E-08028 Barcelona, Spain) **Rhamnolipid-enhanced solubilization and biodegradation of PAHs in soils after conventional bioremediation. Science of The Total Environment, Volume 668 (2019) : 790-796**

The application of a rhamnolipid biosurfactant for enhanced solubilizationand biodegradation of slowly desorbing polycyclic aromatic hydrocarbons(PAHs) in contaminated soils was determined in this study. The soil samples exhibited different levels of pollution and different bioremediation stages: the first soil originated from a creosote-polluted site, contained 4370 mg kg −1 of PAHs and had not been bioremediated; the second soil was the same as the first but had received bioremediation treatment with nutrient amendment in biopiles for a period of 5 months and contained 580 mg kg −1 of PAHs after this treatment; the third soil was treated by bioremediation for several years to reduce the concentration of PAHs to 275 mg kg −1. The kinetics of PAH desorption were determined to assess the magnitude of the slowly desorbing fractions present in the polluted soil and to optimize the biosurfactant effectiveness in terms of biodegradation. The soils that had been treated by bioremediation were enriched in slowly desorbing PAHs. The rhamnolipid at a concentration above its critical micelle concentration enhanced biodegradation in the soils that had been bioremediated previously. The measurement of residual concentrations of native PAHs showed the promoting effect of the biosurfactant on the biodegradation of the slowly desorbing fractions. Interestingly, benzo(a)pyrene was biodegraded in the soil that had been bioremediated for a long time. Rhamnolipid can constitute a valid alternative to chemical surfactants in promoting the biodegradation of slow-desorption

PAHs, which is one of the most important problems in bioremediation, but the efficiency depends strongly on the bioremediation stage in which the biosurfactant is applied.

Keywords: Biodegradation; Polycyclic aromatic hydrocarbons; Biosurfactants; Bioremediation

M.S.Sankar[1], PadmanavaDash[1], ShatrughanSingh[1], YueHanLu[23], Andrew E.Mercer[1]ShuoChen[2] ([1]Department of Geosciences, Mississippi State University, Mississippi State, MS 39762, USA[2]Department of Geological Sciences, University of Alabama, Tuscaloosa, AL 35487, USA[3]Academy for Advanced Interdisciplinary Studies, Southern University of Science and Technology, Shenzhen, Guangdong 518055, China) **Effect of photo-biodegradation and biodegradation on the biogeochemical cycling of dissolved organic matter across diverse surface water bodies. Journal of Environmental Sciences, Volume 77 (2019) : 130-147**

The objective of this research was to quantify the temporal variation of dissolved organic matter (DOM) in five distinct waterbodies in watershedswith diverse types of land use and land cover in the presence and absence of sunlight. The water bodies were an agricultural pond, a lake in a forested watershed, a man-made reservoir, an estuary, and a bay. Two sets of samples were prepared by dispensing unfiltered samples into filtered samples in 1:10 ratio (*V/V*). The first set was exposed to sunlight (10 hr per day for 30 days) for examining the combined effect of photo-biodegradation, while the second set was stored in dark for examining biodegradation alone. Spectroscopic measurements in tandem with multivariate statistics were used to interpret DOM lability and composition. The results suggest that the agricultural pond behaved differently compared to other study locations during degradationexperiments due to the presence of higher amount of microbial humic-like and protein-like components derived from microbial/anthropogenic sources. For all samples, a larger decrease in dissolved organic carbon (DOC) concentration (10.12% ± 9.81% for photo-biodegradation and 6.65% ± 2.83% for biodegradation) and rapid transformation of DOM components (*i.e.*, terrestrial humic-like components into microbial humic and protein-like components) were observed during photo-biodegradation experiments. Results suggest that sunlight facilitated DOM biodegradation, resulting in simpler recalcitrant molecules regardless of original composition. Overall, it was found that combined effects of light and bacteria are more efficient than bacterial effects alone in remineralizing and altering DOM, which highlights the crucial importance of sunlight in transforming aquatic DOM.

Keywords: Photo-biodegradation; Biodegradation; Dissolved organic matter; Land use and land cover; Half-life; EEM-PARAFAC

Chia-SueiHung[a], Daniel E.Barlow[c], Vanessa A.Varaljay[ab], Carrie A.Drake[ab], Audra L.Crouch[ab], John N.RussellJr.[c], Lloyd J.Nadeau[a], Wendy J.Crookes-Goodson[a]Justin C.Biffinger[d] ([a]Soft Matter Materials Branch, Materials and Manufacturing Directorate, Air Force Research Laboratory, Wright-Patterson AFB, OH, USA[b]UES, Inc., Dayton, OH, USA[c]Chemistry Division, US Naval Research Laboratory, Washington, DC, USA[d]Chemistry Department, University of Dayton, 300 College Park, Dayton, OH, 45469, USA) **The biodegradation of polyester and polyester polyurethane coatings using *Papiliotrema laurentii.* International Biodeterioration & Biodegradation, Volume 139 (2019) : 34-43**

The rate and severity of polyurethane (PU) coating degradation is due to a combination of both abiotic and biotic factors. The contribution of biotic factors to the degradation process has not been fully realized, in part, because it is assumed that microorganisms cannot survive exclusively on polyurethane-based coatings. We isolated a strain of *Papiliotrema laurentii* that, as a biofilm, is capable of degrading a polyester-based polyurethane coating. The biodegradation potential of this strain was screened initially with Impranil®-DLN and then against biodegradable polyesters (polyethylene succinate and polyethylene adipate) and a thermoset polyester polyether polyurethane, Irogran®, with no additional carbon sources over 8 days at a relative humidity of >95%. We confirmed that *P. laurentii* preferentially hydrolyzed both polyesters coatings and the polyester segment of Irogran® coatings using optical and infrared microscopy techniques. The chemical and metabolic differences observed during the degradation of PES coatings compared to PEA and Irogran® coatings indicate that growth was not required for these coatings to be degraded. This strain of *P. laurentii* can both hydrolyzeand metabolize polyester-based coatings under high humidity over 8 days. These microscopic and analytical data revealed how biodegradation was potentially linked to survival using this fungus isolated from the environment.

Keywords: Biodegradation; Polyurethane; Polyester; Yeast; Biofilm

JinlongLi[ab], JingfanZhang[ab], Madhav P.Yadav[c], XiutingLi[ab] ([a]Beijing Advanced Innovation Center for Food Nutrition and Human Health, Beijing Technology and Business University, Beijing 100048, PR China[b]Beijing Higher Institution Engineering Research Center of Food Additives and Ingredients, Beijing 100048, PR China[c]U.S. Department of Agriculture, Agricultural Research Service, Eastern Regional Research Center, 600 East Mermaid Lane, Wyndmoor, PA 19038, United States) **Biodegradability and biodegradation pathway of di-(2-ethylhexyl) phthalate by *Burkholderia pyrrocinia* B1213. Chemosphere, Volume 225 (2019) : 443-450**

This study was conducted to investigate the biodegradation of di-(2-ethylhexyl) phthalate (DEHP) by *Burkholderia pyrrocinia* B1213. The results showed that DEHP at concentration of 500 mg/L in a mineral salt medium containing 1.0% yeast extract can be almost completely degraded (98.05%) by strain B1213. The optimal condition for DEHP degradation was pH 7.0, temperature 30 °C. Moreover, B1213 shows better degradation effect on long-chain PAEs, such as DEHP, which provides a great potential for its use in bioremediation of soils contaminated with PAEs. The kinetic studies showed that DEHP depletion curves fit well to the modified Gompertz model. The mono(2-ethylhexyl) phthalate (MEHP), mono-dibutyl phthalate (MBP), phthalic acid (PA) and 4-oxo-hexanoic acid were identified as the metabolitesof DEHP by HPLC-ESI-QTOFMS. The detection of MBP and 4-oxo-hexanoic acid as intermediates prompted us to propose a novel and more complete DEHP biodegradation pathway compared to the classic pathway: DEHP is first degraded to MEHP by esterases, which is then converted to MBP through β-oxidation. Then MBP is degraded to PA by esterases, which is then converted to protocatechuate (PCA) under aerobic conditions rapidly. PCA is ultimately cleaved to generate CO_2 and H_2O via 4-oxo-hexanoic acid.

Keywords: Biodegradation; DEHP; *Burkholderia pyrrocinia* sp.; Kinetics; Pathway

JuliaC.Forsythe[a], SteveKenyon-Roberts[b], MartinO'Donnell[b], Soraya S.Betancourt[c], NicoleMasurek[d], AdriaanGisolf[e], BarryBennett[f], Robert K.Nelson[g], Jesus A.Canas[c]Christopher M.Reddy[g]Ken E.Peters[c]Julian Y.Zuo[c]Oliver C.Mullins[a]

([a]Schlumberger-Doll Research, United States[b]Premier Oil Company, United Kingdom[c]Schlumberger SIS, United States[d]Schlumberger, PetroMod, Germany[e]Schlumberger, Wireline UK, United Kingdom[f]Schlumberger Labs, Canada[g]Woods Hole Oceanographic Institution, United States) Biodegradation and water washing in a spill-fill sequence of oilfields. Fuel, Volume 237 (2019) : 707-719

A recent paper delineated the variations in crude oil in five oilfields (seven reservoirs); large differences in biodegradation and water washing were reported in accord with expectations of the spill-fill sequence of trap filling [1]. Here, the deepest oilfield, Catcher, with the best quality crude oil is examined in detail. Among different oilfields, the extent of water washing is tightly coupled to the extent of (ongoing) biodegradation. Moreover, in-reservoir gradients of biodegradation and water washing are also highly correlated supporting the previous finding that, for cases of ongoing biodegradation, water washing can be assisted by biodegradation. Further support for this process is obtained with a detailed analysis of alkylbenzenesand alkylnaphthalenes that show elimination in accordance with water solubility, yet scale with the extent of biodegradation. Ongoing biodegradation accelerates water washing; once water-soluble components enter the aquifer, they are consumed by microbes maintaining a flux of these components into the aquifer and eliminating the corresponding need for (slow) diffusion of these components away from the oil-water contact. In addition, the oil gradient in the Catcher oilfield is affected by the change in biodegradation of the crude oil spilling into Catcher from a deeper, subsiding reservoir causing a large gradient at the top of the oil column. Factors that determine oil type in charge are discussed. This paper extends the range of measurement of water washing in these reservoirs to a factor 10,000 in water solubility. All data herein are consistent with biodegradation and biodegradation-assisted water washing occurring in reservoir, not in migration.

Keywords: Biodegradation; Water washing; Biodegradation-assisted water washing;Fluid gradients; Recharge gradients; GCxGC; Reservoir fluid geodynamics

ŁukaszLawniczak[a], RomanMarecik[b] ([a]Faculty of Chemical Technology, Poznan University of Technology, Berdychowo 4, 60-965, Poznań, Poland[b]Department of Biotechnology and Food Microbiology, University of Life Sciences in Poznań, Wojska Polskiego 48, 60-627, Poznań, Poland) Comparison of metalworking fluids biodegradation efficiency by autochthonous and environmental communities. Journal of Environmental Management, Volume 232 (2019) : 625-635

The aim of this study was to evaluate the biodegradation potential of microbiota isolated from different environmental niches towards different types of metalworking fluids (MWF). The first experimental stage was focused on the assessment of biochemical oxygen demand reduction efficiency of autochthonous and environmental microbial communities. Based on the obtained results, the following order describing the biodegradation potential of communities from the studied niches was established: petroleumcontaminated soil > waste repository ≥ waste MWF tanks > pesticide-treated field > activated sludge > municipal sewage effluents. For comparative purposes, the most efficient community originating from petroleumcontaminated soil (PCS1) was selected for further studies along with the most efficient community originating from a waste MWF tank (WMT1). The studied communities achieved 100% biodegradation efficiency of decanedioic and

dodecanedioic acids as well as glycerine and polyethoxylated dodecanol. However, the PCS1 community was more versatile and displayed significantly higher biodegradation efficiency of mineral oil (80% compared to 50% in case of WMT1). Similarly, experiments using pristine and spent MWF solutions confirmed that the PCS1 community outperformed the WMT1 community during the biodegradation of MWF containing oil as the main component(COD reduction of 80, 60 and 30% in case of semi-synthetic MWF, soluble oil and spent MWF, respectively). Results of community dynamics assessment using quantitative real-time PCR after the biodegradation of different types of MWF confirmed that the PCS1 community was characterized by high geneticstability and allowed to indicate the potential 'key players'.

Keywords: Bacterial communities; Biodegradation; Community dynamics; Metalworking fluids

Biosensor

GaojianYang[a], ZiqiXiao[a], CongliTang[a], YanDeng[ab], HaoHuang[a], ZiyuHe[a] ([a]Hunan Key Laboratory of Biomedical Nanomaterials and Devices, Hunan University of Technology, Zhuzhou, 412007, PR China[b]State Key Laboratory of Bioelectronics, National Demonstration Center for Experimental Biomedical Engineering Education (Southeast University), School of Biological Science and Medical Engineering, Southeast University, Nanjing, 210096, PR China). Recent advances in biosensor for detection of lung cancer biomarkers. Biosensors and Bioelectronics, Volume 141 (2019): 111416

Lung cancer is primary cancer threatening human life worldwide with the highest mortality rate. The early detection of lung cancer plays a critical role in the early diagnosis and subsequent treatment. However, the conventional methodologies limit the applications due to the low sensitivity, being expensive, and invasive procedure. Tumor markers as biochemical parameters can reflect cancer occurrence and progression, which show sensitivity, convenience, and low cost in developing biosensors, and act as good candidates for fabricating biosensors of detecting lung cancer. This review describes various biosensors (2013-2019) for detection of lung cancer biomarkers. Firstly, the various reported tumor markers of lung cancer are briefly described. Then, the advancements of designing biosensors for sensitive, stable, and selective identification of lung cancer biomarkers are systematically provided, with a specific focus on the main clinical biomarkers such as neuron-specific enolase (NSE), cytokeratin 19 fragment (CYFRA 21-1). Finally, the recent challenges and further opportunities for developing effective biosensors for early diagnosis of lung cancer are discussed.

Keywords: Lung cancer; Tumor markers; Biosensors; Detection

Ewen O.BlairDamion K.Corrigan. (Department of Biomedical Engineering, University of Strathclyde, Glasgow, G4 0NS, UK) A review of microfabricated electrochemical biosensors for DNA detection. Biosensors and Bioelectronics, Volume 134 (2019) : 57-67

This review article presents an overview of recent work on electrochemical biosensors developed using microfabrication processes, particularly sensors used to achieve sensitive and specific detection of DNA sequences. Such devices are important as they lend themselves to miniaturisation, reproducible mass-manufacture, and integration with other previously existing technologies and production methods. The review describes the current state of

these biosensors, novel methods used to produce them or enhance their sensing properties, and pathways to deployment of a complete point-of-care biosensing system in a clinical setting.

Keywords: Biosensor; Microfabrication; Electrode; DNA sensor; Thin films

Chinnu Sabu T.K.Henna V.R.Raphey K.P.Nivitha K.Pramod[1] (College of Pharmaceutical Sciences, Govt. Medical College, Kozhikode – 673008, Kerala, India) Advanced biosensors for glucose and insulin. Biosensors and Bioelectronics, 2019

Diabetes mellitus is a chronic metabolic disorder lasting for the lifetime of a person. Glucose and insulin are the main indicators in the monitoring and control of this disease. Most often, various laboratory tests are used in the diagnosis and control of diabetes. Among them, the estimation of blood glucose concentration is one of the main diagnostic criteria. Proper control of the blood glucose level can delay, and to a greater extent, prevent complications. Thus, blood glucose monitoring is a requisite tool in the management of diabetes mellitus. Insulin plays a major role in glucose metabolism and its determination is of great value in the diagnosis and control of diabetes. An uncountable number of biosensors have been developed based on various mechanisms which will make sure a continuous glucose as well as insulin monitoring. Biosensors became the most sophisticated tool for the detection of glucose and insulin and they are of different types. Enzymatic, non-enzymatic, electrochemical, optical, non-invasive, and continuous monitoring biosensors are discussed in this review. In recent years, there is progress towards the development of nanobiosensors using various nanomaterials. Here, we have reviewed the fabrication, modification and recent approaches associated with insulin and glucose biosensors for treatment of diabetes.

Keywords: Biosensor; Glucose; Insulin; Nanomaterial; Nanobiosensor; Diabetes

Chandra Shekhar Pundir[a], Mansi Malik[b], Reeti Chaudhary[b] ([a]Department of Biochemistry, M.D. University, Rohtak, Haryana, India[b]Department of Biotechnology, Deenbandhu Chhotu Ram University of Science and Technology, Murthal, Sonipat, Haryana, India) Quantification of pyruvate with special emphasis on biosensors: A review. Microchemical Journal, Volume 146 (2019) : 1102-1112

Pyruvate (carboxylate anion of pyruvic acid) is an organic molecule, with a backbone of 3-carbon atoms. Pyruvate is known to undergo several fates depending upon the organism under consideration. It is one of the only molecules involved in both synthesis and breakdown pathways, thereby making it a very busy molecule. Aberrant levels of this metabolite are known to cause several disorders like diabetes, cirrhosis, cardiovascular diseases and severe brain abnormalities. This is an attractive candidate for bodybuilders as a supplement, and also holds an important position in the food and beverage industry. Recent research also showed pyruvate as a screening molecule for cancer. Thereby, detection of this metabolite is an important aspect from the clinical and diagnostic point of view. Conventional methods available for the detection of pyruvate had several disadvantages such as tedious, time-consuming, non-specific, expensive instrumental setup, the requirement of trained personnel's, especially for chromatographic

techniques. Biosensing techniques overcome these pitfalls, as these are easy, highly sensitive and fast. Pyruvate biosensors deciphered till date work optimally within 6–180 s, between pH ranging from 5.7 to 7.0 and temperature 30–35 °C and pyruvate concentration ranging from 4 to 16,000 µM. Numerous biosensors have been elucidated to detect pyruvate levels in biological fluids like serum of diseased patients, calf serum and in food products like yogurt, onion and garlic. This review illustrates the various analytical parameters for pyruvate determination with a special focus on pyruvate biosensors. Also, the future scope for improvement and enhancement of pyruvate biosensors are discussed.

Keywords: Pyruvate; Pyruvate biosensor; Biosensor; Nanotechnology; Amperometric

Zhaoxia Shi Gongke Li Yufei Hu. (School of Chemistry, Sun Yat-sen University, Guangzhou 520175, China) Progress on the application of electrochemiluminescence biosensor based on nanomaterials. Chinese Chemical Letters, 2019

Electrogenerated chemiluminescence, also known as electrochemiluminescence, abbreviated ECL, is a new technology combining electrochemistry and chemiluminescence. It is generated by high-energy electrons generated on the surface of the electrode in the emission process of excited state photons formed in the transfer process, and is a perfect combination of electrochemistry and spectroscopy. It not only has the advantages of good environment, high luminosity and wide dynamic range, but also has the characteristics of simple, stable and practical electrochemical methods, and nearly zero background signals. With the rapid development of nanomaterials, due to their unique electrical properties, large specific surface area, good biocompatibility and other characteristics, various nanomaterials have been widely used in the field of biosensors and sensitive detection. This review presented a general description of the research status of four different types of biosensors from the last decade years, summarized the application forms of nanomaterials in ECL biosensor, and outlines the building patterns and application example of the four main types of biosensors.

Keywords: Electrochemiluminescence; Nanomaterials; Disease diagnosis;Biosensor; Quantitative determination; Application progress

Hendri Wasito[ac], Amin Fatoni[bc], Dadan Hermawan[b], Sri Sutji Susilowati[a]. ([a]Department of Pharmacy, Faculty of Health Sciences, Jenderal Soedirman University, Purwokerto 53123, Indonesia[b]Department of Chemistry, Faculty of Mathematics and Natural sciences, Jenderal Soedirman University, Purwokerto 53123, Indonesia[c]Biosensory Technology Division, Center for Maritime Biosciences Studies, Jenderal Soedirman University, Purwokerto 53123, Indonesia) Immobilized bacterial biosensor for rapid and effective monitoring of acute toxicity in water. Ecotoxicology and Environmental Safety, Volume 170 (2019) : 205-209

The use of biosensors by using microorganisms such as bacteria have short life cycles and provide other advantages. One colorimetric biosensor technique that has been developed is the use of a biosensor utilizing the incorporation of Prussian blue formation reactions mediated by *E. coli*bioreactors with ferricyanide. Immobilization is a method that allows the bacteria can be used for long-term without reducing its ability as bioreceptor. This study aimed to develop a novel and rapid immobilized bacterial biosensor for the detection of toxic compound in water and to evaluate their analytical performances. Immobilization of *E. coli* performed by trapping method using alginate material support. The bacterial suspension was mixed with sodium

alginate (1:1 v/v), and the mixture was continuously dropped in $CaCl_2$ solution to be a form of beads. The beads were used as bioreceptor to detect toxicants regarding cadmium, arsenic, mercury, chromium and lead solutions with Prussian blue as a colorimetric indicator. The linearity and sensitivity of detection of beads to the toxicants were tested, the stability of repeated use and storage were evaluated as well. The results showed that *E. coli*could be immobilized using alginate with response value was correlated with toxic concentration. The developed biosensor was more stable when used repeatedly and could be stored in a long time. The immobilization of *E. coli* in calcium alginate bead was successfully performed as a biosensor system for monitoring acute toxicity in water.

Keywords: Water; Toxicant; Environment; Biosensor

Cheng-YuLee[a], Chi-HsiangLiao[a], Jen-TeTso[a], You-ZungHsieh[ab] ([a]Department of Applied Chemistry, National Chiao Tung University, Hsinchu, Taiwan ROC[b]Center for Emergent Functional Matter Science, National Chiao Tung University, Hsinchu, Taiwan ROC) **A pyrophosphatase biosensor with photocurrent analysis. Sensors and Actuators B: Chemical, Volume 284 (2019) : 159-163**

A light-induced photochemical biosensor was developed for the analysis of inorganic pyrophosphatase (PPase). PPase hydrolyzes pyrophosphate (PPi) into two independent *o*-phosphate ions. Two PPi units can chelate a copper ion (Cu^{2+}), forming a PPi–Cu^{2+}–PPi complex and preventing the Cu^{2+} triggers other reactions. A transparent indium tin oxide (ITO) electrode was coated with a layer of CdS quantum dots (QDs), and then 3,4-diaminobenzoic acid (DBA) was deposited as the anchor. A solution of the PPi–Cu^{2+}–PPi complex and *o*-phenylenediamine (OPD) was mixed with the analytical sample and then a drop of the mixture was placed on the modified ITO electrode. In the absence of PPase, no reaction occurred between OPD and DBA. A photocurrent was obtained upon excitation of the CdS QDs under light. In the presence of PPase, Cu^{2+} was released from the complex, triggering the reaction of OPD with DBA on the electrode surface, thereby shielding the CdS QDs from excitation by the light. The observed photocurrent decreased. The difference in the two measured photocurrents corresponded to the activity of PPase. This photochemical biosensor had excellent sensitivity for PPase in the range from 0.8 to 5000 mU, with a limit of detection of 0.41 mU.

Keywords: Biosensor; PPase; Photocurrent; Quantum dots; *o*-Phenylenediamine

RozitaAbolhasan[ab], AmirMehdizadeh[c], Mohammad RezaRashidi[d], LeiliAghebati-Maleki[eg], MehdiYousefi[fg] ([a]Stem Cell Research Center, Tabriz University of Medical Sciences, Tabriz, Iran[b]Student Research Committee, Tabriz University of Medical Sciences, Tabriz, Iran[c]Endocrine Research Center, Tabriz University of Medical Sciences, Tabriz, Iran[d]Research Center for Pharmaceutical Nanotechnology, Tabriz University of Medical Sciences, Tabriz, Iran[e]Immunology Research Center, Tabriz University of Medical Sciences, Tabriz, Iran[f]Aging Research Institute, Tabriz University of Medical Sciences, Tabriz, Iran[g]Department of Immunology, Faculty of Medical Sciences, Tabriz University of Medical Sciences, Tabriz, Iran) **Application of hairpin DNA-based biosensors with various signal amplification strategies in clinical diagnosis. Biosensors and Bioelectronics, Volume 129 (2019) : 164-174**

Biosensors have been commonly used in biomedical diagnostic tools in recent years, because of a wide range of application, such as point-of-care monitoring of treatment and disease progression, drug discovery, commonly use foodcontrol, environmental monitoring and biomedical research. Additionally, development of DNA biosensors has been increased enormously over the past few years as confirmed by the large number of scientific publications in this field. A wide range of techniques can be used for the development of DNA biosensors, such as DNA nano-machines and various signal amplificationstrategies. This article selectively reviews the recent advances in DNA base biosensors with various signal amplification strategies for detection of cancer DNA and microRNA, infectious microorganisms, and toxic metal ions.

Keywords: DNA biosensors; Diagnosis; Signal amplification

HidayahShahar[a], Ling LingTan[a], Goh ChooTa[a], Lee YookHeng[b] ([a]Southeast Asia Disaster Prevention Research Initiative (SEADPRI-UKM), Institute for Environment and Development (LESTARI), Universiti Kebangsaan Malaysia (UKM), 43600, UKM Bangi, Selangor Darul Ehsan, Malaysia[b]School of Chemical Sciences and Food Technology, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600, UKM Bangi, Selangor Darul Ehsan, Malaysia) **Detection of halogenated hydrocarbon pollutants using enzymatic reflectance biosensor. Sensors and Actuators B: Chemical, Volume 281 (2019) : 80-89**

A reflectometric biosensor for enzymatic determination of halogenated organic pollutant in environmental water sample was developed. Polyacrylate microspheres modified with succinimide functional groups were employed as the substrate matrix for covalent immobilization of haloalkane dehalogenase (DhlA) enzyme, and ETH5294 Nile Blue chromoionophore (NBC) pH dye was physically immobilized on the acrylic micromatrix to function as an optical proton sensor. The hydrolytic dehalogenation of halocarbon catalyzed by the immobilized DhlA resulting in the release of a halogen and a proton, which protonated the immobilized NBC proton indicator, and a colour change of the biosensor from violet to blue was measured with a reflectance spectrophotometer for indirect quantification of the halogenated hydrocarbon concentration. The enzymatic halocarbon reflectance biosensor exhibited a dynamic linear response range of 1–30 mg L^{-1} 1,2-dichloroethane (DCA) ($R^2 = 0.9762$) with a detection limit of 0.3 mg L^{-1}. The proposed enzymatic biosensor gave rapid response, within 2 min, towards the detection of 50 mg L^{-1} DCA at 662 nm, and demonstrated stable response up to 6 days of storage period at 4 °C and pH 8.0. Validation between the developed biosensor with standard gas chromatography–electron capture detector (GC-ECD) showed that both methods have a comparable accuracy in detecting halocarbon species.

Keywords: Enzymatic biosensor; Haloalkane dehalogenase; Halogenated hydrocarbon; Optical biosensor; Reflectance spectrophotometry

Bioengineering

ZhenxingZhang[ad], LinaCao[b], ZiyuZhu[c], ChunguangHe[d], HongyongXiang[e], LiangXu[f], CaiyunSun[f]ChenluLin[a]HaijunYang[ad]KunLi[d] ([a]Institute of Grassland Science, Northeast Normal University, and Key Laboratory of Vegetation Ecology, Ministry of Education, Changchun 130024, Jilin, China[b]Environmental Protection Department of Jilin Province,

Changchun, Jilin 130024, China[c]School of Life Sciences, Northeast Normal University, Changchun, Jilin 130024, China[d]State Environmental Protection Key Laboratory of Wetland Ecology and Vegetation Restoration, School of Environment, Northeast Normal University, Changchun, Jilin 130024, China[e]Institute of Integrative Biology, University of Liverpool, L69 7ZB Liverpool, United Kingdom[f]Jilin Institute of Chemical Technology, Jilin 132000, China) Evaluation on soil bioengineering measures in agricultural areas: Poorer durability of wooden structures and better aboveground habitat improvements. Ecological Engineering,Volume 129 (2019) : 1-10

Although soil bioengineering is increasingly used worldwide, the measures being used today are still based on an empirical approach. Most of the existing literature has primarily focused on mechanical soil reinforcement provided by plant roots and the search for available indigenous plant species, whereas wooden structures and aboveground habitat improvements have been poorly addressed in the literature. Nevertheless, it is of great importance to identify and replicate the most durable structural forms and parameters of bioengineering measures, especially during the initial phase of plant colonization. This paper mainly presents an evaluation of the effect of time (restoration ages), structural forms and structural parameters (materials and construction standards) on wooden structural durability and aboveground habitat improvements using soil bioengineering measures in agricultural areas. The results indicate that the wooden structural durability declines over time, and can be impacted by restoration ages, structural forms and structural parameters, whereas, aboveground habitat improvements measures show a positive response to restoration ages and structural parameters. The wooden structural form with multi-row timber piles (e.g., TTP) and structural parameter (e.g., Project A) was significantly more durable than were others. A temporary warning value (restoration age 7, seven years after the completion of the project) for the reconstruction of tilted timber piles is proposed, and two approaches are proposed regarding higher survival rate at restoration age one. The structural parameters of Project A showed a significantly better affect only for plant height from restoration age 6 to restoration age 9, and significantly higher amphibian abundance within the same restoration age, which means the measure of A may provide a better habitat than that of B. These results confirm the efficacy of this type of streambank soil bioengineering measure in agricultural areas and indicate its future application, and raise practical and scientific issues regarding structural durability and aboveground ecological restoration for management as well as for studies related to design improvement.

Keywords: Soil bioengineering; Wooden structure; Timber piles; Willow cuttings; Amphibians

SandeepKumar, VishwakarmaAvinash, Bardia Chandrakala, Lakkireddy Nagarapu, RajuSyed Ameer BashaPaspala, Md. AejazHabeebAleem, AhmedKhan. (Central Laboratory for Stem Cell Research and Translational Medicine, Centre for Liver Research and Diagnostics, Deccan College of Medical Sciences, Kanchanbagh, Hyderabad 500058, Telangana, India Dr. Habeebullah Life Sciences, Attapur, Hyderabad 500048, Telangana, India) Intraperitoneal transplantation of bioengineered humanized liver grafts supports failing liver in acute condition. Materials Science and Engineering: C,Volume 98 (2019) : 861-873

Acute liver failure (ALF) is one of the most devastating fatal conditions which have posed crucial challenges to the clinicians and researchers for identifying permanent cure. Currently

liver transplantation has been considered as the only managerial option. However it's wider applicability has been limited owing to non-availability of quality donor organs, cost-intensiveness, surgical hitches, life-long use of immunosuppressive drugs and long-term complications. Since last decades, several liver support systems have been developed for the management of failing liver in acute condition. However, the major limitation has been the lack of natural biological support and long-term survival of the grafts post-transplantation. Repopulation of decellularized xenogeneic organs is one of the emerging technologies for development of humanized neo-organs for demanding regenerative application. However, the earlier reported studies do not fulfil the insistence to provide immunologically tolerable humanized liver grafts for clinical applications. Here we demonstrate an efficient approach to generate transplantable humanized liver grafts which provides long-term support to the failing liver in Acute Liver Failure (ALF) animal models. These bioengineered humanized liver tissue grafts expresses several liver specific transcripts and performed crucial synthetic (albumin production) and detoxification (urea synthesis) functions at comparative level to normal liver. Intraperitoneal transplantation of these humanized liver grafts offered favourable microenvironment to exchange toxic substances across the barrier during ALF condition and provided long-term survival and function of the graft. In summary, the results of present study provide a first proof of concept in pre-clinical ALF animal model for the applicability of these bioengineered humanized livers in the management of failing liver on demand and may be considered as potential bridge to liver transplantation.

Keywords: Acute liver failure; Stem cells transplantation; Tissue engineering; Bioengineering humanized livers

XinLi[ac†], YeTian[bc†], Mei-JuanTu[c], Pui YanHo[c], NeeluBatra[c], Ai-MingYu[c] **([a]Key Laboratory of Molecular Target & Clinical Pharmacology, School of Pharmaceutical Sciences & the Fifth Affiliated Hospital, Guangzhou Medical University, Guangzhou 511436, China[b]Lab for Bone Metabolism, Key Lab for Space Biosciences and Biotechnology, School of Life Sciences, Northwestern Polytechnical University, Xi′an 710072, China[c]Department of Biochemistry & Molecular Medicine, UC Davis School of Medicine, Sacramento, CA 95817, USA)** **Bioengineered miR-27b-3p and miR-328-3p modulate drug metabolism and disposition *via*the regulation of target ADME gene expression. Acta Pharmaceutica Sinica B, Volume 9, Issue 3 (2019) : 639-647**

Drug-metabolizing enzymes, transporters, and nuclear receptors are essential for the absorption, distribution, metabolism, and excretion (ADME) of drugsand xenobiotics. MicroRNAs participate in the regulation of ADME gene expression *via* imperfect complementary Watson Crick base pairings with target transcripts. We have previously reported that Cytochrome P450 3A4(CYP3A4) and ATP-binding cassette sub-family G member 2 (ABCG2) are regulated by miR-27b-3p and miR-328-3p, respectively. Here we employed our newly established RNA bioengineering technology to produce bioengineered RNA agents (BERA), namely BERA/miR-27b-3p and BERA/miR-328-3p, *via*fermentation. When introduced into human cells, BERA/miR-27b-3p and BERA/miR-328-3p were selectively processed to target miRNAs and thus knock down *CYP3A4* and *ABCG2* mRNA and their protein levels, respectively, as compared to cells treated with vehicle or control RNA. Consequently, BERA/miR-27b-3p led to a lower midazolam 1′-hydroxylase activity, indicating the reduction of CYP3A4 activity. Likewise, BERA/miR-328-3p treatment elevated the intracellular accumulation of anticancer drugmitoxantrone, a classic substrate of ABCG2, hence sensitized the cells to chemotherapy. The results indicate that biologic miRNA agents made by RNA

biotechnology may be applied to research on miRNA functions in the regulation of drug metabolism and disposition that could provide insights into the development of more effective therapies.

Keywords: Bioengineered RNA; miR-27b; miR-328; CYP3A4; ABCG2; Drug disposition

F.Rey[a], C.Bifulco[b], G.B.Bischetti[c], F.Bourrier[a], G.DeCesare[d], F.Florineth[e], F.Graf[f], M.Marden[g], S.B.Mickovski[h], C.Phillips[i], K.Peklo[j], J.Poesen[k], D.Polster[l], F.Preti[m], H.P.Rauch[f], P.Raymond[n], P.Sangalli[o]G.Tardio[p]A.Stokes[q] ([a]Univ. Grenoble Alpes, Irstea, UR LESSEM, 2 rue de la Papeterie, BP 76, 38402 Saint-Martin-d'Hères, France[b]Universidade de Lisboa, Instituto Superior de Agronomia, Centro de Ecologia Aplicada Prof. Baeta Neves, Lisboa, Portugal[c]Department of Agricultural and Environmental Science, Università degli Studi di Milano, Milan, Italy[d]Laboratory of Hydraulic Constructions LCH, École Polytechnique Fédérale de Lausanne EPFL, Station 18, CH-1015 Lausanne, Switzerland[e]Institute of Soil Bioengineering and Landscape Construction, Department of Civil Engineering and Natural Hazards, University of Natural Resources and Life Sciences, Vienna, Austria[f]WSL Institute for Snow and Avalanche Research SLF, Flüelastrasse 11, CH-7260 Davos Dorf, Switzerland[g]Landcare Research, PO Box 445, Gisborne 4040, New Zealand[h]School of Engineering and Built Environment, Glasgow Caledonian University, 70 Cowcaddens Rd, Glasgow G4 0BA, Scotland, UK[i]Landcare Research, PO Box 69040, Lincoln 7640, New Zealand[j]I.C.E. Klaus PEKLO, Soil and Fluvial Bioengineering Consultancy SARL, Lasmarios, 82160, Parisot, France[k]Department of Earth and Environmental Sciences, KU Leuven, Celestijnenlaan 200E, B-3001 Heverlee, Belgium[l]Polster Environmental Services, 6015 Mary Street, Duncan, BC V9L 2G5, Canada[m]University Firenze - GESAAF, Engineering for Agro-Forestry and Biosystems Division, WaVe Research Unit, via san Bonaventura 13, 50145 Firenze, Italy[n]Terra Erosion Control Ltd., 308 Hart Street, Nelson, British Columbia V1L5N5, Canada[o]Sangalli Coronel y AsociadosSL, Bioingeniería y Paisaje Montesol, 24-20016 San Sebastian, Spain[p]Technical University of Madrid, Avenida Niceto Alcalá Zamora 6 4D, Getafe, Madrid 28905, Spain[q]INRA, AMAP, CNRS, IRD, University Montpellier, CIRAD, Montpellier, France) **Soil and water bioengineering: Practice and research needs for reconciling natural hazard control and ecological restoration. Science of The Total Environment, Volume 648 (2019) : 1210-1218**

Soil and water bioengineering is a technology that encourages scientists and practitioners to combine their knowledge and skills in the management of ecosystems with a common goal to maximize benefits to both man and the natural environment. It involves techniques that use plants as living building materials, for: (i) natural hazard control (e.g., soil erosion, torrential floods and landslides) and (ii) ecological restoration or nature-based re-introduction of species on degraded lands, river embankments, and disturbed environments. For a bioengineering project to be successful, engineers are required to highlight all the potential benefits and ecosystem services by documenting the technical, ecological, economic and social values. The novel approaches used by bioengineers raise questions for researchers and necessitate innovation from practitioners to design bioengineering concepts and techniques. Our objective in this paper, therefore, is to highlight the practice and research needs in soil and water bioengineering for reconciling natural hazard control and ecological restoration. Firstly, we

review the definition and development of bioengineering technology, while stressing issues concerning the design, implementation, and monitoring of bioengineering actions. Secondly, we highlight the need to reconcile natural hazard control and ecological restoration by posing novel practice and research questions.

Keywords: Benefits; Biodiversity; Ecological engineering; Ecosystem services; Erosion; Vegetation

JianWang[a]ShuKong[a]FangmingChen[a]WeiChen[a]LipingDu[a]WenCai[a]LiquanHuang[b]ChunshengWu[a]De-WenZhang[a] ([a]Institute of Medical Engineering, Department of Biophysics, School of Basic Medical Sciences, Health Science Center, Xi'an Jiaotong University, Xi'an, 710061, China[b]College of Life Sciences, Zhejiang University, Hangzhou, 310031, China) **A bioelectronic taste sensor based on bioengineered *Escherichia coli* cells combined with ITO-constructed electrochemical sensors. Analytica Chimica Acta, 2019**

In this study, we developed a novel bioelectronic taste sensor for the detection of specific bitter substances. A human bitter taste receptor, hT2R4, was efficiently expressed in *Escherichia coli* (*E. coli*), which was used as the primary recognition element. A simple and low-cost electrochemical device based on ITO-based electrolyte-semiconductor (ES) structure was innovatively employed as the transducer to assess bacterial metabolic consequences of receptor activation in real time. An apparent increase in extracellular acidification rate was observed, which was resulted from the triggering of hT2R4 receptors by their target ligand of denatonium. The sensor showed dose-dependent responses to denatonuim ranging from 50 nM to 500 nM, while non-bioengineered bacteria without hT2R4 receptors exhibited negligible responses to the same stimulus. In addition, the specificity of the proposed taste biosensor was verified using other typical bitter substances such as quinine and alpha-naphthylthiourea (ANTU). This research provides a simple and inexpensive approach for the construction of bioelectronic taste sensors.

Keywords: taste receptor; cell acidification; ITO-based ES sensor; *E. coli* cells

K.Hayes[a], D.Field[b], C.Hill[b], F.O' Halloran[a], L.Cotter[a]. ([a]Cork Institute of Technology, Bishopstown, Cork, Ireland[b]School of Microbiology, University College Cork, Ireland) **A novel bioengineered derivative of nisin displays enhanced antimicrobial activity against clinical *Streptococcus agalactiae* isolates. Journal of Global Antimicrobial Resistance, 2019**

Streptococcus agalactiae (*S. agalactiae*) is the leading cause of neonatal disease worldwide and infections caused by this opportunistic pathogen are becoming increasingly more prevalent in adults. With the global incidence of antibiotic resistance continuing to rise, there is a recognised need for new therapeutic agents. Nisin is a potent antimicrobial peptide that has demonstrated broad spectrum activity against a range of clinically significant pathogens.

This study aimed to examine the efficacy of nisin against a clinical population of *S. agalactiae* strains and further investigate the bioactivity of a novel bioengineered derivative of the peptide, designated nisin PV.

A deferred antagonism assay was used to assess the bioactivity of wild type nisin and nisin PV against *S. agalactiae* strains (n = 122). MICs were evaluated to determine the specific activity of

both peptides. The genetic basis of nisin resistance among the collection of strains was investigated by PCR detection of the *nsr* gene.

In total 91% of the collection showed some level of susceptibility to nisin while 9% displayed complete resistance. Interestingly, the nisin derivative exhibited enhanced antimicrobial activity for 64.8% of isolates. The frequency of the *nsr* gene, which confers nisin resistance, was also investigated and the gene was detected in 98.4% of isolates suggesting that resistance may be linked to levels of expression of the protein or other regulatory elements.

This study indicates that there is potential for use of nisin and its derivatives as therapeutic agents against *S. agalactiae* infections.

Keywords: *Streptococcus agalactiae;* Antimicrobials; Susceptibility; Nisin; Bacteriocins; Bioengineering

G.Basu[a], A.N.Roy[a], P.Sanyal[a], K.Mitra[a], L.Mishra[a], S.K.Ghosh[b]. ([a]ICAR-National Institute of Natural Fibre Engineering and Technology, Kolkata, 700040, India[b]Department of Jute and Fibre Technology, University of Calcutta, Kolkata, 700019, India) **ioengineering of river earth embankment using natural fibre-based composite-structured geotextiles. Geotextiles and Geomembranes, 2019**

A Jute-HDPE composite structured geotextile was developed to improve the performance of earthen structure of river embankment. The optimized geotextiles (430 g/m^2) containing 86% natural component (on weight) having better physical, mechanical (tensile strength, 10 kN/m (machine direction) and 18 kN/m (cross direction), index puncture (163 kN) and CBR (1.5 kN)), hydraulic(AOS 178 μ) and endurance properties than 100% HDPE geotextiles. A coconut fibre geotextile net was placed over jute-polyolefin geotextiles to resist washing-off of loose cover soil until the establishment of vegetation. Placing of continuous seamless geotextile tube (weight 196.2 kg/m) filled with moist river sand at the anchor trench-cum-toe guard assisted in safeguarding from eddies. It was observed that initially closed structure of the geotextile assisted in efficient filtration leading to soil stabilization through compactness of soil layer (14 cm thick). The uniqueness of work lies in conversion of closed structure of geotextiles to open-mesh of HDPE slit film on degradation of jute, remained beneath the cover-soil, through which grass root penetrated the geotextiles sheet and riveted both the layers of soil, the cover and the compacted back layers. The remnant synthetic part thus acts as durablereinforcing element and its increased porosity provides breathability for growth of soil flora and fauna. Bermuda grass turf provided very high nailing strength (658.8 kN/m^2) with the soil through intertwining of grass roots with durable synthetic network.

Keywords: Geosynthetics; Bioengineering; HDPE; Jute; Properties; Structure

Pollen Biotechnology

YanFucheng[a1], ZhangZheng[a1], LinYichun[a], LiYang[a], ZhangLuying[b], PengJiaxian[b], ZhangWei[a], ZhouShumin[a], LuSenlin[b] ([a]Lab of Plant Development, Shanghai Key Laboratory of Bio-Energy Crops, Plant Science Center, School of Life Sciences, Shanghai

University, Shanghai, 200444, China[b]School of Environmental and Chemical Engineering, Shanghai University, Shanghai, 200444, China) Subpollens delivery of *Platanus acerifolia* pollen allergen Pla a3 and nucleic acid into lungs and cells. Biochemical and Biophysical Research Communications, Volume 513, Issue 4 (2019) : 767-774

Pollen allergy is a very serious seasonal respiratory disease. However, there has been a lack of understanding how pollen allergens enter the body and act on cells. This study focused on the release, transport and characteristic of Pla a3 allergen of the *Platanus acerifolia* pollen. Pla a3 protein was purified by prokaryotic expression system for preparation of polyclonal antibody. The distribution and release of Pla a3 protein in pollen were observed by immunohistochemistry. Mice were immunized with purified Pla a3 protein and SPPs, respectively. The pathological examination of mouse lung tissue proved that SPPs, as a fine particle in the range of 0.1-1μm, can enter the deep part of the lung directly through the respiratory tract and led to inflammation. Furthermore, DAPI staining confirmed a certain amount of nucleic acids in SPPs. After incubation with SPPs for 6 h, the Pla a3 mRNA could be detected in A549 cells by PCR. This suggests that nucleic acid wrapped in SPPs could be delivered into A549 cells. These results could provide a new clue and experimental data accumulation for further study on the mechanism of pollen sensitization.

Keywords: SPPs; Allergen; Nucleic acid; Micro airway; Pollen allergy

AsjaRadja[1], Eric M.Horsley[1], Maxim O.Lavrentovich[23], Alison M.Sweeney[134] ([1]Department of Physics and Astronomy, University of Pennsylvania, 209 S. 33rd Street, Philadelphia, PA 19104, USA[2]Department of Physics and Astronomy, University of Tennessee, 1408 Circle Drive, Knoxville, TN 37996, USA) Pollen Cell Wall Patterns Form from Modulated Phases. Cell .Volume 176, Issue 4 (2019) : 856-868

The ornately geometric walls of pollen grains have inspired scientists for decades. We show that the evolved diversity of these patterns is entirely recapitulated by a biophysical model in which an initially uniform polysaccharide layer in the extracellular space, mechanically coupled to the cell membrane, phase separates to a spatially modulated state. Experiments reveal this process occurring in living cells. We observe that in ∼10% of extant species, this phase separation reaches equilibrium during development such that individual pollen grains are identical and perfectly reproducible. About 90% of species undergo an arrest of this process prior to equilibrium such that individual grains are similar but inexact copies. Equilibrium patterns have appeared multiple times during the evolution of seed plants, but selection does not favor these states. This framework for pattern development provides a route to rationalizing the surface textures of other secreted structures, such as cell walls and insect cuticle.

Keywords: Pollen;pattern formation; self-assembly; phase transition; cell membrane; spatially modulated phase; cell wall; biophysics; primexine; exine

YuanyuanWang, HongbinTao, BeijingTian, DechangSheng, ChenchenXu, HemingZhouShoubingHuangPuWang (College of Agronomy and Biotechnology, China Agricultural University, Beijing 100193, China) Flowering dynamics, pollen, and pistil contribution to grain yield in response to high temperature during maize flowering. Environmental and Experimental Botany, Volume 158 (2019) : 80-88

High temperature (HT) stress during flowering severely threatens crop grain yield, however, little is known about the underlying mechanisms in maize. A HT sensitive maize hybrid was subjected to 32/22 ℃ (maximum/minimum temperature, control), 36/26 ℃, and 40/30 ℃ for 14 consecutive days bracketing flowering (trial 1) and for seven days prior to flowering (trial 2). Maize grain yield did not decrease in the 36/26 ℃ treatment during trial 1 compared to the control treatment, but reduced by 73.6% in the 40/30 ℃ treatment as a result of reduced kernel number rather than kernel weight. High temperature stress advanced tasseling and pollen shedding, extended the anthesis-silking interval, and reduced the number and viability of pollen shed, but had no effects on silking. The shortened duration of pollen shedding was a result of the accelerated flowering speed of the tassel inflorescence. Leaf assimilate can be transferred to the tassel, but cannot be converted into starch in the HT stressed pollen. The damaged pollen morphology and the interrupted sugar to starch physiological process explained the reduced pollen viability. Starch granule number and size in the pollen decreased with the increased temperature. Thus, male organ growth is more sensitive to HT than female organs. Understanding the underlying mechanisms has implications for selecting or breeding HT tolerant maize.

Keywords: Maize; High temperature; Flowering dynamic; Pollen shedding; Pollen viability

GuangcongDu[ac], JinguangXu[b], ChengrongGao[b], JieLu[b], QianLi[ac], JieDu[ac], MengwenLv[ac], XiaSun[ac] ([a]College of Horticulture, Shandong Agricultural University, Tai'an, 271018, Shandong, China[b]Forestry Seedlings and Flower Department, Forestry Bureau of Shandong, Jinan, 250014, Shandong, China[c]State Key Laboratory of Crop Biology, Tai'an, 271018, Shandong, China) **Effect of low storage temperature on pollen viability of fifteen herbaceous peonies. Biotechnology Reports, Volume 21 (2019)**

In order to develop rich new varieties of peony flowers and solve the problems associated with non-synchronised flowering, a study was conducted to investigate pollen viability of fifteen herbaceous peony cultivars. Pollen was stored for more than one year under four storage conditions (4 °C, −4 °C, −20 °C, and −76 °C). In vitro germination and the I_2-KI staining method were used to test pollen viability. For all cultivars, pollen stored at −76 °C showed a significantly slower rate of viability reduction when compared to all the other storage conditions. The differential results obtained using different pollen viability assays confirmed that the in vitro germination test showed lower viability compared to I_2-KI staining method. The pollen tube length grew longer as storage temperature rose such as 'Hongfeng'. From the present study, it has been proved that the I_2-KI staining method is more convenient and reliable than the in vitro germination test. Herbaceous peony pollen can be stored at 4 °C for hand-pollination among cultivars having non-synchronised flowering in a season, and that different storage temperature is suited to different herbaceous peony pollen for more than one year.

Keywords: Herbaceous peony; Pollen viability; In vitro germination; I_2-KI staining method; Cross pollination

QilinLiu[a], XiaoqinLi[b], YuWu[a], MiaoqingQing[c], GuangqunTan[a], DanXiao[abc] ([a]College of Chemical Engineering, Sichuan University, Chengdu 610065, PR China[b]Institute of New Energy and Low-Carbon Technology, Sichuan University, Chengdu 610065, PR China[c]College of Chemistry, Sichuan University, Chengdu 610065, PR China) **Pine pollen**

derived porous carbon with efficient capacitive deionization performance. Electrochimica Acta, Volume 298 (2019) : 360-371

Capacitive deionization (CDI) is a powerful brackish water desalinationtechnology and one of the effective measures to solve the shortage of freshwater resources. With the hope to design a material with efficient desalination performance, we develop a simple, fast and green method to prepare porous carbon. The pine pollen disruption powder is used as the carbon precursor to prepare porous carbon by a simple high temperature calcination. We explore the effect of temperature on the morphology, pores and electrosorption performance, discovering the material calcined at 900 °C (PC-900) is the optimal one. PC-900 exhibits the electrosorption capacity of 7.25 mg g^{-1} at a low initial concentration of NaCl (50.5 μS cm^{-1}) and 19.43 mg g^{-1} at a high initial concentration of NaCl (500 μS cm^{-1}). Moreover, the synthesized material also shows improved exhibited salt removal rate, charge efficiency, reversibility and recycling stability. The excellent desalination performance is mainly attributed to the large specific surface area and suitable pore size. This result demonstrates that is porous carbon derived from pine pollen disruption powder is a promising CDI electrode material for brackish water desalination.

Keywords: Capacitive deionization; Biomass; Pine pollen; Potential of zero charge

Yan-minLIU[a], Yun-heLI[a], Xiu-pingCHEN[a], Xin-yuanSONG[b], PingSHEN[c], Yu-faPENG[a] ([a]State Key Laboratory for Biology of Plant Diseases and Insect Pests, Institute of Plant Protection, Chinese Academy of Agricultural Sciences, Beijing 100193, P.R.China[b]Jilin Academy of Agricultural Sciences, Changchun 130124, P.R.China[c]Science and Technology Development Center, Ministry of Agriculture, Beijing 100122, P.R.China) **No detrimental effect of Bt maize pollen containing Cry1Ab/2Aj or Cry1Ac on adult green lacewings *Chrysoperla sinica* Tjeder. Journal of Integrative Agriculture, Volume 18, Issue 4 (2019) : 893-899**

Adult *Chrysoperla sinica* Tjeder is a common pollen feeder in maize fields. They are thus directly exposed to insecticidal proteins by consumption of genetically engineered maize pollen containing *Bacillus thuringiensis* (Bt) proteins. Here we assessed the potential effects of Cry1Ab/2Aj- or Cry1Ac-containing Bt maize pollen on the fitness of adult *C. sinica via* a dietary-exposure assay under laboratory conditions. Survival, pre-oviposition, fecundity and adult dry weight did not differ between adult *C. sinica*consuming Bt or the corresponding non-Bt maize pollen. The stability of the Cry protein in the food sources and uptake of the Cry protein by adult *C. sinica*during the feeding experiment were confirmed by ELISA. These results demonstrate that adult *C. sinica* are not affected by the consumption of Cry1Ab/2Aj- or Cry1Ac-containing maize pollen, suggesting that production of Bt maize expressing *cry1Ab/2Aj* or *cry1Ac* genes will pose a negligible risk to adult *C. sinica.*

Keywords: non-target effect; nvironmental risk assessment; ELISAdietary exposure assay

ZhongyuanHu[abc], ShanrongLan[a], NingZhao[a], NanSu[a], QinXue[a], JieLiu[a], QinDeng[a], JinghuaYang[abc], MingfangZhang[abc] ([a]Laboratory of Germplasm Innovation and Molecular Breeding, Institute of Vegetable Science, Zhejiang University, Hangzhou, Zhejiang, PR China[b]Key laboratory of Horticultural Plant Growth, Development & Quality Improvement, Ministry of Agriculture, Hangzhou, Zhejiang, PR China[c]Zhejiang

Provincial Key Laboratory of Horticultural Plant Integrative Biology, Hangzhou, Zhejiang, PR China) Soft-X-irradiated pollens induce parthenocarpy in watermelon via rapid changes of hormone-signalings and hormonal regulation. Scientia Horticulturae, Volume 250 (2019) : 317-328

Parthenocarpy, the natural or artificial induced fruit production without fertilization of ovules, confers various agricultural benefits, such as stable crop production in fluctuating environments, as well as increased fruit quality and shelf-life of some fleshy fruits. Whereas, phytohormones are known as important mediators of the fertilization-independent fruiting. Here, diploid parthenocarpic watermelon was produced by pollination with partially functional pollen, which was irradiated with soft-X-rays. Ovule transcriptome analyses demonstrated both irradiated and normal pollen induced complex hormone-regulation during fruit-set, and quick response of auxin signaling and downstream network may be crucial for fruit-set. Dynamic investigation of phytohormones in fertilized ovaries suggested soft-X-irradiated pollen induced the accumulation of gibberellins (GAs), cytokinins (CKs) and auxin as normal pollen did. Exogenous application of hormones or inhibitors suggested auxin may specifically act in fruit-set, whereas GAs is insufficient to induce parthenocarpy but function in fruit-growth stage. Single treatment of 1-(2-chloro-4-pyridyl)-3-phenylurea (CPPU, an active CK) could induce parthenocarpic fruit-set and subsequent growth, which might partly dependent on induced auxin accumulation in fruits. Our results will contribute to the potential breeding of vegetative (autonomous) parthenocarpic watermelon cultivar via genetic engineering, as well as provide useful insights into the mechanisms underlying parthenocarpy in cucurbit crops.

Keywords: Ovule transcriptome analysis; Parthenocarpy; Phytohormone; Soft-X-ray; Watermelon

HuguesRenault[1], DanièleWerck-Reichhart[1], Jing-KeWeng[23] **([1]Institute of Plant Molecular Biology, CNRS UPR 2357, University of Strasbourg, F-67000 Strasbourg, France[2]Whitehead Institute for Biomedical Research, 455 Main Street, Cambridge, MA 02142, USA[3]Department of Biology, Massachusetts Institute of Technology, Cambridge, MA 02139, USA)** **Harnessing lignin evolution for biotechnological applications. Current Opinion in Biotechnology, Volume 56 (2019) : 105-111**

Lignin evolved concomitantly with the rise of vascular plants on planet earth ~450 million years ago. Several iterations of exploiting ancestral phenylpropanoid metabolism for biopolymers occurred prior to lignin that facilitated early plants' adaptation to terrestrial environments. The first true lignin was constructed via oxidative coupling of a number of simple phenylpropanoid alcohols to form a sturdy polymer that supports long-distance water transport. This invention has directly contributed to the dominance of vascular plants in the Earth's flora, and has had a profound impact on the establishment of the rich terrestrial ecosystems as we know them today. Within vascular plants, new lignin traits continued to emerge with expanded biological functions pertinent to host fitness under complex environmental niches. Understanding the chemical and biochemical basis for lignin's evolution in diverse plants therefore offers new opportunities and tools for engineering desirable lignin traits in crops with economic significance.

AnkurDatta[ab1], SaibalMoitra[a1], Sk Md OmarFaruk[a], Prasanta K.Das[a], SomnathMondal[ab], ImanHazra[a], Anjan K.Basu[c], Santanu K.Tripathi[b], SwapnaChaudhuri[a] ([a]Department of

Laboratory Medicine, School of Tropical Medicine, 108 C. R. Avenue, Kolkata, 700073, West Bengal, India[b]Department of Clinical & Experimental Pharmacology, School of Tropical Medicine, 108 C. R. Avenue, Kolkata, 700073, West Bengal, India[c]Department of Biochemistry & Medical Biotechnology, School of Tropical Medicine, 108 C. R. Avenue, Kolkata, 700073, West Bengal, India) **Unravelling the apoptotic mechanisms in T-lymphocytes in an animal model for pollen induced airway allergy and studying the impact of specific immunotherapy. Immunobiology, Volume 224, Issue 2 (2019) : 183-195**

Asthma is a chronic inflammatory disorder of the airways, increasing in prevalence worldwide. Reduced T cell apoptosis may interfere with the down-regulation of an immune response resulting in T cell accumulation contributing to the chronic inflammation of asthma. Most studies focused so far on apoptosis of eosinophils but the detailed role of T lymphocytes apoptosis in allergic diseases is unclear yet. The present experimental study was designed to discern the modulation of various apoptotic proteins of splenic T lymphocytes in a previously established rat model of *Alstonia scholaris* pollen induced airway allergy. Flowcytometry, immunoblotting, and immunofluorescence imaging techniques were employed for the present investigation. Annexin-V studies registered early apoptotic rate of lymphocytes with allergen sensitization and challenge which was corrected following mucosal immunotherapy. The study demonstrates that allergen sensitization and challenge reduced apoptosis of splenic T-lymphocytes via Fas mediated extrinsic pathway, Bax/Bcl2 regulated intrinsic pathway and also perforin/granzyme mediated pathway which were normalized following allergen specific intranasal immunotherapy. Inadequate T cell apoptosis in asthma appears to interfere with normal T cell elimination, resulting in T cell accumulation, which contributes to chronic inflammation and may be the major underlying cause for tissue damage which can be modulated by intranasal immunotherapy. Thus the apoptosis inducing effect of allergen immunotherapy necessitates more studies to elaborate on its effects on various effector cells of airway inflammation.

Keywords: Apoptosis; T-lymphocytes; Intranasal immunotherapy; Asthma; Pollen allergy; Rat model

M.Vakili Moghaddam[ab], M.Fallahpour[c], M.Mohammadi[d], F.S.Rasi Varaee[a], K.Mokhtarian[e], M.Khoshmirsafa[ag], R.Jafari[f], N.Shirzad[b], R.Falak[ag] ([a]Immunology Research Center, Iran University of Medical Sciences, Tehran, Iran[b]Department of Immunology, School of Medicine, Shahrekord University of Medical Sciences, Shahrekord, Iran[c]Department of Allergy and Clinical Immunology, Iran University of Medical Sciences, Tehran, Iran[d]Persian Gulf Marine Biotechnology Research Center, Persian Gulf Biomedical Sciences Research Institute, Bushehr University of Medical Sciences, Bushehr, Iran[e]Clinical Biochemistry Research Center, Basic Health Sciences Institute, Shahrekord University of Medical Sciences, Shahrekord, Iran[f]Department of Immunology, School of Medicine, Shahroud University of Medical Sciences, Shahroud, Iran[g]Department of Immunology, School of Medicine, Iran University of Medical Sciences, Tehran, Iran) **Identification of polcalcin as a novel allergen of *Amaranthus retroflexus* pollen. Allergologia et Immunopathologia, (2019)**

Amaranthus retroflexus (Redroot Pigweed) is one of the main sources of allergenic pollens in temperate areas. Polcalcin is a well-known panallergen involved in cross-reactivity between

different plants. The aim of this study was the molecular cloning and expression of polcalcin, as well as evaluating its IgE-reactivity with *A. retroflexus* sensitive patients' sera.

Allergenic extract was prepared from *A. retroflexus* pollen and the IgE-reactivity profile was determined by ELISA and immunoblotting using sera from twenty *A. retroflexus* sensitive patients. Polcalcin-coding sequence was amplified by conventional PCR method and the product was inserted into pET-21b(+) vector. The recombinant protein was expressed in E. coli BL21 and purified by metal affinity chromatography. The IgE-binding capability of the recombinantprotein was analyzed by ELISA and immunoblotting assays, and compared with crude extract.

Of 20 skin prick test positive patients, 17 patients were positive in IgE-specific ELISA. Western blotting confirmed that approximately 53% of ELISA positive patients reacted with 10 kDa protein in crude extract. The *A. retroflexus*polcalcin gene, encoding to 80 amino acid residues was cloned and expressed as a soluble protein and designated as Ama r 3. The recombinant polcalcin showed rather identical IgE-reactivity in ELISA and western blotting with 10 kDa protein in crude extract. These results were confirmed by inhibition methods, too.

The recombinant form of *A. retroflexus* polcalcin (Ama r 3) could be easily produced in *E. coli* in a soluble form and shows rather similar IgE-reactivity with its natural counterpart.

Keywords: Allergen characterization; *Amaranthus retroflexus;* Cloning; Polcalcin

Biotechnology Policy Issue

Sebastian M.Pfotenhauer[a], JoakimJuhl[b], ErikAarden[c] ([a]Munich Center for Technology in Society (MCTS) and TUM School of Management, Technical University Munich, Germany[b]Department of Planning and Development, Aalborg University, Denmark[c]Department of Science and Technology Studies, University of Vienna, Austria)
Challenging the "deficit model" of innovation: Framing policy issues under the innovation imperative. Research Policy, Volume 48, Issue 4 (2019) : 895-904

As innovation is increasingly becoming an imperative for policymakers around the globe, there is a growing tendency to frame policy problems as problems of innovation. This logic suggests that we are unable to address grand societal challenges and ensure economic competitiveness *because* our societies, institutions, scientific activities or individual predispositions are not sufficiently geared towards innovation. In this paper, we analyze this "deficit model" of innovation in which a lack of innovation is routinely invoked as the main obstacle to social progress. Drawing parallels to research on the deficit model of public understanding of science (PUS), we develop a theoretical framework that captures the dynamics and normative implications of deficit construction, highlighting five salient dimensions: problem diagnoses, proposed remedies, the role of expertise, implied social orders, and measures of success. We apply this framework to three empirical case studies of recent innovation strategies in Luxembourg, Singapore, and Denmark. Attention to this deficit framing around innovation is

important, we argue, because it is an essential part of how innovation transforms societies in the 21st century: not only through new technological possibilities or economic growth, but also by shaping public discourse, narrowing policy options, and legitimizing major institutional interventions. The implied pro-innovation bias tends to marginalize other rationales, values, and social functions that do not explicitly support innovation. It further delegates decisions about sweeping social reconfigurations to innovation experts, which raises questions of accountability and democratic governance. Experiences from the history of PUS suggest that, without a dedicated effort to transform innovation policy into a more democratic, inclusive, and explicitly political field, the present deficit logic and its technocratic overtones risks significant social and political conflict.

Keywords: Innovation policy; Deficit model; Public understanding of science; Innovation imperative; Comparison; National innovation strategies

TimoMitze[abc], FalkStrotebeck[d] ([a]Department of Business and Economics, University of Southern Denmark, Denmark[b]RWI Essen, Germany[c]Rimini Centre for Economic Analysis (RCEA), Canada[d]Fachhochschule Südwestfalen, Germany) Modeling interregional research collaborations in German biotechnology using industry directory data. Data in Brief, Volume 22 (2019) : 169-180

This article describes a data set to map and model research collaborations in German biotechnology. Underlying micro-data for firms and institutions in the biotech sector together with information on their research collaboration partners have been extracted from a commercial industry directory, the BIOCOM Year and Address book, for 2005 and 2009. The data have been processed and aggregated to the level of NUTS3 regions. This core data set has been linked to regional covariates which measure the regional endowment with biotech-related research capacities, sector-specific S&T policy support and the strength of a region′s overall local innovation system. The full data set, which is attached to this article, offers applied researchers an alternative source of information for empirical analyses of knowledge flows in research networks and for studying their determinants. Potential fields of application include social network and regression analysis. First empirical results are reported in “Determining factors of interregional research collaboration in Germany′s biotech network: Capacity, proximity, policy?” (Mitze and Strotebeck, 2018) and “Centrality and get-richer mechanisms in interregional knowledge networks” (Mitze and Strotebeck, 2018).

Keywords: Biotechnology; Research collaborations; Industry directory data; Regional innovation system; S&T policy

AntonioAndreoni[a], Ha-JoonChang[b], RobertoScazzieri[c] ([a]Department of Economics, SOAS University of London, United Kingdom and South African Research Chair in Industrial Development, University of Johannesburg, South Africa[b]Faculty of Economics and Centre of Development Studies, University of Cambridge, United Kingdom[c]Department of Economics, University of Bologna, Accademia Nazionale dei Lincei, Roma, Gonville and Caius College and Clare Hall, Cambridge, United Kingdom) Industrial policy in context: Building blocks for an integrated and comparative political economy agenda. Structural Change and Economic Dynamics, Volume 48 (2019) : 1-6

This article introduces the special issue *Frontiers of Industrial Policy* by assessing the recent academic and policy debates and pointing to the need for a renewed industrial policy agenda centred on the *structure-institution-policy nexus*. We argue that this agenda should be informed by historical studies revealing the context-specific dynamics of production transformation. Second, we argue that it should address industrial, technical and market-related issues, as much as the political economy of production transformation. Third, we suggest a more holistic view of industrial policy. In particular we stress the importance of framing industrial policy within a more holistic framework whereby the pervasive role that industrial policy plays across several policy domains can be better understood. We finally introduce the articles in the special issue and highlight their different, albeit complementary, contributions to this agenda.

Keywords: Industrial policy; Context-specific dynamics; Structural-institutional-policy nexus; Comparative political economy

Zulma S.Vásquez[a], Dão P.de Carvalho Neto[a], Gilberto V.M.Pereira[a], Luciana P.S.Vandenberghe[a], Priscilla Z.de Oliveira[a], Patrick B.Tiburcio[a], Hervé L.G.Rogez[b], AristótelesGóes Neto[c], Carlos R.Soccol[a] ([a]Bioprocess Engineering and Biotechnology Department, Federal University of Paraná (UFPR), 81531-980 Curitiba, PR, Brazil[b]Centre for Valorisation of Amazonian Bioactive Compounds (CVACBA), Federal University of Pará, 66075-750 Belém, PA, Brazil[c]Federal University of Minas Gerais, Institute of Biological Sciences, 31270-901 Belo Horizonte, MG, Brazil) Biotechnological approaches for cocoa waste management: A review. Waste Management, Volume 90 (2019) : 72-83

Cocoa beans provide raw materials for global food industries valued in excess of $47 billion in world exportations. Through on-farm processing, about 80% of cocoa fruit is discarded as residual biomass, including cocoa pod husks, cocoa bean shells and cocoa sweatings. Farmers routinely discard these residues/by-products during the initial cocoa bean processing steps, occupying vast areas and raising social and environmental concerns. Alternatively, this residual biomass is used as cocoa tree fertilizer. However, its disposal is performed without proper treatment, resulting in putrid odors and plant diseases. Recently, some studies have reported the use of cocoa by-products in the production of high-value-adding molecules with potential applications in the food, pharmaceutical and cosmetic industries. In this aspect, biotechnological approaches have been shown to be a viable alternative for the transformation of this residual biomass into fine products. This article reviews the biotechnological approaches implemented for the management and exploitation of cocoa by-product. Related topics on cocoa production and residual biomass generation, sustainability and valorization of cocoa chain are addressed and discussed.

Keywords: Cocoa; Cocoa by-products; Residual waste valorization

Agricultural Biotechnology

L.H.M.Figueiredo[ab], A.G.Vasconcellos[c], G.S.Prado[ad], M.F.Grossi-de-Sa[ad] ([a]EMBRAPA Genetic Resources and Biotechnology, Final W5 Norte, CP 02372 Brasília, DF, Brazil.[b]University of Brasilia (UnB), Brasília, DF, Brazil, [c]National Institute of Industrial Property/INPI, Rua Mayrink Veiga, 9 – Centro, Rio de Janeiro, RJ, Brazil, [d]Catholic University of Brasilia, Brasilia, DF, Brazil). An overview of intellectual property within

agricultural biotechnology in Brazil. Biotechnology Research and Innovation, Volume 3, Issue 1(2019): 69-79

Brazilian agricultural biotechnology has seen great advances in recent decades, especially in the development of GM crops, including soybean, cotton, and maize, which has placed Brazil in second place since 2013 in the ranking of countries with the greatest GM-cultivated area. However, patenting these technologies is somewhat more restrictive in Brazil than in other countries, such as the USA and Japan, especially concerning isolated biological material from nature. Hence, the intellectual protection of crops in Brazil is encompassed by *sui generis* rights and/or the patenting of only the development process. Given the current scenario and the importance of biotechnology for the Brazilian agriculture sector, it is necessary to deeply study the patent system for recently developed technologies to identify opportunities for enterprises and national institutes to act in this area. The application of novel biotechnological strategies to agriculture will contribute to the expanding agriculture sector and become part of the solution to global challenges. Through this study, we can identify the major companies developing and protecting their agrobiotechnologies. Additionally, a more detailed analysis verifies that although there are some restrictions in Brazilian laws, GM patent applicants find ways to obtain intellectual protection for the tools they use in the development of GM crops, which include regulatory sequences, gene constructs and production methodologies. Mechanisms to stimulate investment in Brazilian research companies and public policies must be consolidated, allowing investment and public–private partnerships in this sector, with the aim of applying biotechnological knowledge and turn it into products demanded by society.

Keywords: Agrobiotechnology; GM crops; Intellectual property

Miguel García-Sancho[a], Dmitriy Myelnikov[b] ([a]Science, Technology and Innovation Studies, University of Edinburgh, UK[b]Centre for the History of Science, Technology and Medicine, University of Manchester, UK) Between mice and sheep: Biotechnology, agricultural science and animal models in late-twentieth century Edinburgh. Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences Volume 75 (2019) : 24-33

In this paper, we investigate the ways in which a group of scientists in Edinburgh worked across mice and sheep during the last quarter of the twentieth century. With this local episode, we show the utility of an interspecies perspective to investigate recent historical transformations in the life sciences. We argue that the emergence of animal biotechnology was the result of interactions between neoliberal policymakers, science administrators, molecular biologists, agricultural breeders, and the laboratoryand farm organisms with which they worked. During the early 1980s, all these actors believed that the exportation of genetic engineering techniques from mice to farm animals would lead to more effective breeding programmes in the agricultural sciences. However, the circulation of people, money, expertise and infrastructures that the experiments required, as well as the practical constraints of working with mice and sheep, resisted a simple scaling-up from one organism to the other. This displaced the goals of the Edinburgh scientists from the production of transgenic sheep to stem cell research and human regenerative medicine. We account for this unexpected shift by looking at the interplay between science policy and its implementation via collective action and bench work

across different organisms. The emergence of animal biotechnology in Edinburgh also provides historiographical insights on the birth of Dolly the sheep and, more generally, on the interactions between the molecular and the reproductive sciences at the fall of the twentieth century.

Keywords: Genetic; Embryology; Agricultural biotechnology; Animal model; Dolly; Neoliberalism

Nur SazwaniDaudAbd Rahman JabirMohd DinMohamad AzzuanRosliZaheda MohamadAzamNor ZalinaOthmanMohamad RojiSarmidi (Innovation Centre in Agritechnology for Advanced Bioprocess (ICA), UTM Pagoh Research Center, Pagoh Education Hub, 84600, Pagoh, Malaysia) *Paenibacillus polymyxa* bioactive compounds for agricultural and biotechnological applications. Biocatalysis and Agricultural Biotechnology Volume 18 (2019): 101092

Paenibacillus polymyxa is categorized as an endospore-forming bacteriumand Gram-positive bacteria, which have innate beneficial properties in modern biotechnology application. *P. polymyxa* extensively reviewed as plant growth promoting bacteria which directly gave benefit to the plants by improving nitrogen fixation from atmosphere, increase phosphorus solubilization and iron acquisition in soil and phytohormone production. This could reduce reliance on chemical fertilizers, which is now a source of environmental conflict and appear to be harmful to human. Therefore, application of *P. polymyxa* focusing only as functional microbial species in production of biofertilizers. *P. polymyxa* have been gaining momentum over the last couple of years. The recent discovery in microbial industrial of this bacterium is the production of bioactive compounds like exopolysaccharides(EPS). EPS is not only established as biofilm for the colonization of microbesand act as a sink for the nutrients on plant roots in the rhizosphere. Hence, EPS from *P. polymyxa* is also useful for health care industries such as disease diagnosis and drug manufacturing. Synthesis of hydrolytic enzymes reported as bioconversion of agricultural wastes that helps to tackle serious environmental problems by creating wealth from waste which can also acts as productive biocontrol agents against pathogens. Hence, *P. polymyxa* having a wide range of antibacterial metabolites and antifungal compounds, inform of volatile organic compouds, peptides and hydrolytic enzymes, This compounds and biomaterials could be commercially marketed as reliable plant biocontrol agents and pharmaceutical application. Nowadays, researcher extensively reviewed and focused their attention on the potential benefits of *P. polymyxa* with multiple biological functions that cannot be ignored for human health and wellness.

Keywords: *Paenibacillus polymyxa;* Biofertilizer; Antimicrobial agents; Exopolysaccharide; Biocontrol; Enzymes

Angela P.Van de Wouw Alexander Idnurm. (School of BioSciences, The University of Melbourne, VIC 3010, Australia). Biotechnological potential of engineering pathogen effector proteins for use in plant disease management. Biotechnology Advances, Volume 37(6)(2019):107387

A key component in the management of many diseases of crops is the use of plant disease resistance genes. However, the discovery and then sequence identification of these plant genes is challenging, whereas the characterization of the molecules that they recognize, the

effector/avirulence products in pathogens, is often considerably more straight forward. Effectors are small proteins secreted by pathogens that can play major roles in modulating a plant's defense against attack. Effectors can be used to guide breeding of resistance genes, to trigger defense responses, and are part of integrated disease management strategies for crop protection. This review covers the role of effector-driven biotechnology in controlling plant diseases caused by fungior oomycetes. Given that multi-billion dollar agriculture crops are based in some cases on plants recognizing just a handful of such effector proteins, there is considerable scope to use more fully effector proteins as a biotechnology resource in agriculture.

Keywords: Avirulence; Hypersensitive response; Immunity; Resistance; Small secreted protein

Thomas Efferth. (Department of Pharmaceutical Biology, Institute of Pharmacy and Biochemistry, Johannes Gutenberg University Mainz, Mainz 55128, Germany) Biotechnology Applications of Plant Callus Cultures. Engineering, Volume 5 (2019) : 50-59

In ethnopharmacology, and especially in traditional Chinese medicine, medicinal plants have been used for thousands of years. Similarly, agricultural plants have been used throughout the history of mankind. The recent development of the genetic engineering of plants to produce plants with desirable features adds a new and growing dimension to humanity's usage of plants. The biotechnology of plants has come of age and a plethora of bioengineering applications in this context have been delineated during the past few decades. Callus cultures and suspension cell cultures offer a wide range of usages in pharmacology and pharmacy (including Chinese medicine), as well as in agriculture and horticulture. This review provides a timely overview of the advancements that have been made with callus cultures in these scientific fields. Genetically modified callus cultures by gene technological techniques can be used for the synthesis of bioactive secondary metabolites and for the generation of plants with improved resistance against salt, draft, diseases, and pests. Although the full potential of callus plant culture technology has not yet been exploited, the time has come to develop and market more callus culture-based products.

Keywords: Antibody production; Embryogenesis; Gene technology; Organogenesis; Pharmacology; Phytochemistry; Plant regeneration; Secondary metabolites; Stem cells

Motahhareh Abedinzadeh, Hassan Etesami, Hossein Ali, Ali khan. (Department of Soil Science, University College of Agriculture and Natural Resources, University of Tehran, Tehran, Iran) Characterization of rhizosphere and endophytic bacteria from roots of maize (*Zea mays* L.). plant irrigated with wastewater with biotechnological potential in agriculture. Biotechnology Reports,Volume 21 (2019): e00305

The aim of this study was to characterize culturable rhizosphere and endophytic bacterial isolates isolated from rhizosphere soil and roots of maize plant irrigated with industrial and municipal wastewater in terms of resistance to heavy metals and salinity and plant growth promoting (PGP) traits. Results illustrated that both rhizosphere isolates and endophytic ones had various PGP characteristics in terms of both the number and the production amount of these characteristics. A substantial number of the bacterial isolates (both endophytic isolates and rhizosphere isolates)

were tolerant to heavy metals (multi-metal resistant bacteria). Compared to endophytic isolates, rhizosphere isolates had greater resistance to heavy metals. Both endophytic isolates and rhizosphere ones showed remarkable resistance to salinity (7% NaCl). Based on comparison of 16S rRNA sequences and biochemical tests, the effective isolates, based on having multiple PGP characteristics and higher resistance to heavy metals and salinity, were identified. Isolates N5 and R7 were closely related to ***Bacillus cereus*** and ***Enterobacter cloacae***, respectively. In addition, the ability of rhizosphere strain R7, as a multi-metal resistant bacterium, in the removal of cadmium (Cd) and lead (Pb) by its biomass and colonization of maize roots in the presence of these metals was evaluated. This strain could remove these metals from the solution (46.5–88.95%) and colonize both root surface and inside root of maize (4–7 Log10 CFU (colony–forming unit) g^{-1} fresh root weight) under heavy metal stress. Therefore, it can be concluded that maize plant irrigated with industrial and municipal wastewater harbors salinity and heavy metals–resistant bacteria and may be potential reservoirs for isolating bacteria effective at alleviating heavy metal stress in the plant, reducing accumulation of heavy metals in crops such as maize, and removing heavy metals in aqueous media (bioremediation of heavy metal-contaminated wastewater system).

Keywords: Plant-associated bacteria; Multiple plant growth promoting traits; Heavy metals; Salinity; Metal removal; Industrial and municipal wastewater

ZhiguangQiu[a], EleonoraEgidi[a], HongweiLiu[a], SimranjitKaur[a], Brajesh K.Singh[ab]. ([a]Hawkesbury Institute for the Environment, Western Sydney University, Penrith, NSW, Australia[b]Global Centre for Land-based Innovation, Western Sydney University, Penrith, NSW, Australia) **New frontiers in agriculture productivity: Optimised microbial inoculants and in situ microbiome engineering. Biotechnology Advances, 2019.**

Increasing agricultural productivity is critical to feed the ever-growing humanpopulation. Being linked intimately to plant health, growth and productivity, harnessing the plant microbiome is considered a potentially viable approach for the next green revolution, in an environmentally sustainable way. In recent years, our understanding of drivers, roles, mechanisms, along with knowledge to manipulate the plant microbiome, have significantly advanced. Yet, translating this knowledge to expand farm productivity and sustainability requires the development of solutions for a number of technological and logistic challenges. In this article, we propose new and emerging strategies to improve the survival and activity of microbial inoculants, including using selected indigenous microbes and optimising microbial delivery methods, as well as modern gene editing tools to engineer microbial inoculants. In addition, we identify multiple biochemical and molecular mechanisms and/approaches which can be exploited for microbiome engineering in situ to optimise plant-microbiome interactions for improved farm yields. These novel biotechnological approaches can provide effective tools to attract and maintain activities of crop beneficial microbiota that increase cropperformance in terms of nutrient acquisition, and resistance to biotic and abiotic stresses, resulting in an increased agricultural productivity and sustainability.

Keywords: Agricultural industry; Plant microbiome; Microbial inoculants; Microbiome engineering in situ; Biotechnological tools

M.Kannan[a], D.Mubarakali[b], B.Thiyonila[c], M.Krishnan[cd], B.Padmanaban[a], S.Shantkriti[e]. ([a]Department of Crop Protection, Entomology Laboratory, ICAR-National Research Centre for Banana, Thayanur, Thogamalai Road, Tiruchirappalli, 620 102, Tamil Nadu, India[b]School of Life Sciences, BSA Crescent Institute of Science and Technology, Vandalur, Chennai, 600048, Tamil Nadu, India[c]Insect Molecular Biology Laboratory, Department of Environmental Biotechnology, School of Environmental Sciences, Bharathidasan University, Tiruchirappalli, 620024, Tamil Nadu, India[d]Madurai Kamaraj University, Palkalai Nagar, Madurai, 625021, Tamil Nadu, India[e]Department of Biotechnology, Kalasalingam Academy of Research & Education, Anand Nagar, Krishnankoil, 626126, Tamil Nadu, Indi) Insect gut as a bioresource for potential enzymes - an unexploited area for industrial biotechnology. Biocatalysis and Agricultural Biotechnology,Volume 18, 2019

Recently, insect gut protease has gained great interest in the field of food and industrial biotechnology due to their invisible characteristics and also their ability to act as an alternative source for microbial protease. The insect gut proteases are produced either by themselves or by gut symbiotic microbes, that utilize it for their metabolism. In this review, the importance of insect gut proteases was highlighted in terms of general physio-chemical properties (pH, temperature and metal) and their compatibility with detergents and resistance to solvents with broad applications in various industries such as laundrydetergents, bio-medical, food industry and bio-ethanol production. The production of insect gut protease can be increased through emerging biotechnological techniques to meet out the demand for protease in future.

Keywords: Insect gut protease; Alkaline pH; Temperature tolerant; Detergent additive; Medical;Industrial biotechnology

Bioenergy

José P.Paredes-Sánchez[a], Luis M.López-Ochoa[b], Luis M.López-González[b], JesúsLas-Heras-Casas[b], JorgeXiberta-Bernat[a] ([a]Universidad de Oviedo, Escuela de Ingeniería de Minas, Energía y Materiales, Departamento de Energía, C/ Independencia, 13, 33004, Oviedo, Principado de Asturias, Spain[b]Universidad de La Rioja, Departamento de Ingeniería Mecánica, Edificio Departamental, C/ San José de Calasanz, 31, 26004, Logroño, La Rioja, Spain) Evolution and perspectives of the bioenergy applications in Spain. Journal of Cleaner Production, Volume 213 (2019) : 553-568

To mitigate the effects of global warming, the European Union must reduce its dependence on foreign fossil fuels to produce energy. Biomass from forests and agroforestry residues are a readily available source of domestic renewable energy. However, further technological developments must be made in order to foster its use in machines and thermal engines. The present study analyses the current situation of biomass energy in Spain as well as its future prospects, potential challenges and opportunities moving forward. This analysis is performed through a review based on bioenergy resources, technology and management to provide

recommendations and carry out a more comprehensive energy assessment. Non-food biomass resources are intended to be useful in the development of bioenergy industrial sector. This study is applied to Spain due to its remarkable forests and wealth of agricultural areas. The methodology is based on three phases of energy conversion: resources, technology and management. The main achievements are pathways definition from resource to bioenergy application in Spain. Bioenergy advances offer management drive forces to meeting the energy and environmental challenges in the European Union.

Keywords: Biomass conversion;Bioenergy; Biofuel; Biogas; Sustainability; Spain

AlejandroPadilla-Rivera María Guadalupe, ParedesLeonor, PatriciaGüereca. (Instituto de Ingeniería, Universidad Nacional Autónoma de México, Coyoacán, 04510, México City, Mexico) **A systematic review of the sustainability assessment of bioenergy: The case of gaseous biofuels. Biomass and Bioenergy,Volume 125 (2019) : 79-94**

In recent years, achieving sustainability in renewable energy systems has become important for achieving future economic prosperity and energy security all over the world; therefore, multiple attempts have been made to assess their sustainability. This means that in addition to considering the technological and economic factors, environmental and social aspects should also be considered. However, the wide-ranging concept of sustainability and the various methodological frameworks presented make their interpretation and correct implementation difficult. In this research, through a systematic literature review, we summarize and analyze the current research on the sustainability assessment of bioenergy production/use (also referred as gaseous biofuels) for electricity and heat generation. Sustainability approaches and their underlying factors from the three dimensions of sustainability were consolidated and structured in this systematic review. In addition, a set of indicators (environmental, social and economic) is provided based on the literature analyzed that decision makers can use to evaluate the sustainability performance of bioenergy systems. The main finding indicates that although there are various international efforts on measuring sustainability, only 32 of studies of the 8542 works initially screened (less than 1%) have an integrated approach that considers all three aspects of sustainability, i.e., environmental, economic and social aspects. In most cases, the focus is on one of the three aspects. Additionally, 50% of the studies evaluated included another dimension, i.e., a cultural, institutional or technical dimension. These results support the idea that a multidimensional sustainability assessment is feasible and facilitates decision-making processes towards a sustainable energy future.

Keywords: Sustainability assessment; Systematic review; Bioenergy; Gaseous biofuels; Renewable energy; Sustainability of bioenergy

ElviraBuonocore[a], AlessandroPaletto[b], Giovanni F.Russo[a], Pier PaoloFranzese[a], **([a]Laboratory of Ecodynamics and Sustainable Development, Department of Science and Technology, Parthenope University of Naples, Italy[b]Council for Agricultural Research and Economics -**

Forest Monitoring and Planning Research Unit (CREA-MPF), Villazzano, Trento, Italy) Indicators of environmental performance to assess wood-based bioenergy production: A case study in Northern Italy. Journal of Cleaner Production, Volume 221 (2019) : 242-248

Increased environmental concerns, mainly related to fossil fuels consumption and global climate change, have drawn the attention to the dependence of human society on energy supply. As a consequence of EU Directives setting mandatory renewable energy targets up to 2020, member states are boosting renewable energy and bioenergy production. The use of wood biomass for bioenergy production can entail important benefits, including improved energy security due to a smaller dependence on fossil fuel supply, mitigationof climate impact, and revitalization of rural economies connected to new job opportunities. Nevertheless, bioenergy production also involves environmental and socio-economic concerns. The environmental, economic, and social sustainability of bioenergy production needs to be assessed through a set of multicriteria indicators. In this study, Life Cycle Assessment(LCA) was used to explore the environmental performance of bioenergy production in an Alpine area of Northern Italy. In particular, the environmental impacts of a wood-based bioenergy plant utilizing local residues from wood industries and forestry operations were investigated. The amount of CO_2-eq emissions (0.25 kg CO_2-eq kWh^{-1}) and the fossil demand (0.09 kg oil-eq kWh^{-1}) calculated for the investigated bioenergy plant resulted lower than the values characterizing fossil fuels-based power plants. Yet, the environmental performance of the investigated bioenergy plant was affected by the consumption of methane, still used in the plant to cover peak loads. The results showed that the use of local wood biomass in the investigated Alpine area is a desirable option for recycling wood residues while supporting heat and electricity production. The findings of this study can support local managers and policy makers committed to plan and implement renewable energy strategies and circular economy patterns. In addition, they can be useful to assess the potential upscale of this bioenergy option at regional and national level considering the availability of wood residues (from forestry and industrial sector) while verifying possible operational constraints at larger scales. Future studies could also integrate environmental accounting with other assessment methods exploring the economic profitability and social desirability of wood-based bioenergy production in mountain areas characterized by low population density and large forest cover.

Keywords: Wood biomass; Bioenergy; Environmental accounting; Environmental performance

RobbieClarke[a], AmandaSosa[c], FionnualaMurphy[ab] ([a]Room 3.06, School of Biosystems & Food Engineering, Agriculture Building, UCD Belfield, Dublin 4, Ireland[b]Biosystems Engineering Ltd., NovaUCD, Belfield Innovation Park, University College Dublin, Dublin 4, Ireland[c]Department of Science, Waterford Institute of Technology, Main Campus Cork Road, Waterford City, Co. Waterford, Ireland) **Spatial and life cycle assessment of bioenergy-driven land-use changes in Ireland. Science of The Total Environment, Volume 664 (2019) : 262-275**

Bioenergy crops are forecast to play a significant role if Ireland is to reach the 2020 and beyond targets set by the European Union's Renewable Energy Directive (RED). The aim of this study is to evaluate the environmental impacts associated with the cultivation of bioenergy crops in Ireland including land-use change (LUC) emissions by using geographical information systems (GIS) and Life Cycle Assessment (LCA). In this study, GISis used to identify, and measure LUC changes associated with cultivation of Miscanthus and Short Rotation Coppice (SRC) willow. An LCA study was carried out to estimate the greenhouse

gas (GHG) emissions from the LUC caused by the cultivation of bioenergy crops. The results find that miscanthus caused 86% of all LUC with SRC Willow accounting for 14%. The LCA results identify two major processes that contribute to total GHG emissions; field operations and loss of soil organic carbon (SOC) stocks. Land preparation, harvesting and the production of synthetic fertiliser are found to be the most significant contributors to field emissions. SOC emission for the conversion of pasture to SRC willow accounts for a large proportion of the overall GHG emissions. Conversion of arable land to miscanthus and SRC willow both cause a net reduction of GHG emissions. Sensitivity analysis on the type of fertilisers used and the inclusion of indirect land-use changes (iLUC), highlight the impacts that these have on the overall system performance. The replacement of synthetic fertiliser with biogenic fertiliser reduced overall GHG emissions. The inclusion of general iLUC data results in a large increase in total GHG emissions because of displaced food crops that must be grown elsewhere. The study shows that conversion of arable to miscanthus and SRC willow is preferable when cultivating bioenergy crops while conversion of pasture to SRC willow should be avoided.

Keywords: GIS; LCA; Greenhouse gas emissions; Bioenergy policy; Sustainability

KatrinHeinsoo KadriTali. (Senior Researcher, Estonian University of Life Sciences, Institute of Agricultural and Environmental Sciences, Kreutzwaldi 5D, 51014, Tartu, Estonia) **Can various bioenergy technologies add value to each other? Energy, Volume 175 (2019) : 259-264**

Bioenergy is sustainable and sufficient only if both the production technology and coproduct utilisation are environmentally friendly. Hence, we suggest the establishment of small-scale willow Short Rotation Coppice close to biogasplants to solve the digestate utilisation problems and to promote woodchip production without mineral fertilisers.

Our small-scale experiment with young *Salix* plants revealed that application of biogas digestate increased plant biomass production. However, an overdose of added nutrients can be harmful and cause young plant dieback due to root damage. The impact of digestate on plants in our experiment was similar or even superior to the impact of the original slurry used for anaerobic digestionby the same biogas plant. Therefore we conclude that anaerobic fermentation did not degrade the nutrient uptake by plants and digestate can replace traditional organic fertilisers in non-food crops.

Keywords: Bioenergy; Fertilisation; Salix; Short rotation coppiceSustainability

D.L.Cheng[a], H.H.Ngo[a], W.S.Guo[ab], S.W.Chang[b], D.D.Nguyen[bc], S.M.Kumar[d] ([a]Centre for Technology in Water and Wastewater, School of Civil and Environmental Engineering, University of Technology Sydney, Sydney, NWS 2007, Australia[b]Department of Environmental Energy & Engineering, Kyonggi University, 442-760, Republic of Korea[c]Institution of Research and Development, Duy Tan University, Da Nang, Viet Nam[d]Department of Civil Engineering, Indian Institute of Technology Madras, Chennai, Tamilnadu 600 036, India) **Microalgae biomass from swine wastewater and its conversion to bioenergy. Bioresource Technology, Volume 275 (2019) : 109-122**

Ever-increasing swine wastewater (SW) has become a serious environmental concern. High levels of nutrients and toxic contaminants in SW significantly impact on the ecosystem and public health. On the other hand, swine wastewater is considered as valuable water and nutrient source for microalgae cultivation. The potential for converting the nutrients from SW into valuable biomass and then generating bioenergy from it has drawn increasing attention. For this reason, this review comprehensively discussed the biomass production, SW treatment efficiencies, and bioenergy generation potentials through cultivating microalgae in SW. Microalgae species grow well in SW with large amounts of biomass being produced, despite the impact of various parameters (e.g., nutrients and toxicants levels, cultivation conditions, and bacteria in SW). Pollutants in SW can effectively be removed by harvesting microalgae from SW, and the harvested microalgae biomass elicits high potential for conversion to valuable bioenergy.

Keywords: Swine wastewater; Microalgae; Nutrients; Toxicants; BiomassBioenergy

Giuseppe Pulighe[a], Guido Bonati[a], Marco Colangeli[b], Maria Michela Morese[b], Lorenzo Traverso[b], FlavioLupia[a], CosetteKhawaja[c], RainerJanssen[c], FrancescoFava[d] ([a]CREA Research Centre for Agricultural Policies and Bioeconomy, via Po 14, 00198 Rome, Italy[b]FAO Food and Agriculture Organization of the United Nations, Viale delle Terme di Caracalla, 00153 Rome, Italy[c]WIP Renewable Energies, Sylvensteinstr. 2, D-81369 Munich, Germany[d]ILRI International Livestock Research Institute, P.O. Box 30709, 00100 Nairobi, Kenya) **Ongoing and emerging issues for sustainable bioenergy production on marginal lands in the Mediterranean regions. Renewable and Sustainable Energy Reviews, Volume 103 (2019) : 58-70**

The cultivation of marginal lands for bioenergy production has recently become a topic of research interest for the agronomic and agricultural economy scientific communities. The growing availability of arable land in the Mediterranean regions, as a consequence of the decline of cereal croppingsystems and grain legume, provides ample opportunities for performing successful feedstock production on unmanaged areas. This paper seeks to capture and analyze ongoing and emerging questions concerning bioenergy production on marginal lands in the Mediterranean area in a framework of sustainability indicators. A qualitative methodology was adopted to evaluate the effectiveness of eight critical issues that bio-energy developers, scholars and policymakers should consider in terms of agronomic, techno-economic and methodological practices for growing bioenergy feedstock. The issues investigated on selected case studies are: Greenhouse gas emissions; soil quality; land restoration and phytoremediation capacity; water use and efficiency; biodiversity; land use/cover changes; farmers' willingness and acceptance of new agro-system, and profitability of value chain. Starting from an in-depth analysis of the definition of marginal land from the perspective of ecosystem service cascade, we synthesize how these challenges are nowadays addressed and which are the key bottlenecks, trends and potential directions for guiding future research into bioenergy production in the Mediterranean regions. The findings of this study suggest that dedicated energy crops can be grown on marginal lands with substantial positive effects in terms of sustainability aspects, although more efforts should be carried out through agronomic research especially on water use efficiency and biodiversity conservation, as well as by national and EU institutions and policies for promoting economic opportunities and integration with surrounding agro-ecosystems and farmers' involvement. Developing a site-specific landscape design with the use of Life Cycle Assessment and certification schemes with sustainability indicators is of primary importance for the effective bioenergy production on marginal lands.

Keywords: Bioenergy crops; Marginal land; Biomass production; GBEP sustainability indicators

Mirjam Röder[a], Evelyne Thiffault[b], Celia Martínez-Alonso[c], Fanny SenezGagnon[d], Laurence Paradis[b], PatriciaThornley[a] ([a]Supergen Bioenergy Hub, European Bioenergy Research Institute, School of Engineering & Applied Science, Aston University, Birmingham, B4 7ET, United Kingdom[b]Research Centre on Renewable Materials, Department of Wood and Forest Sciences, Laval University, Quebec City, Qc, G1V 0A6, Canada[c]CETEMAS, Forest and Wood Technology Research Centre, Sustainable Forest Management Area, Pumarabule S/n, 33936, Asturias, Spain[d]Centre for Forest Research, P.O. box 8888, Centre-ville Station, Montréal, Qc, H3C 3P8, Canada) Understanding the timing and variation of greenhouse gas emissions of forest bioenergy systems. Biomass and Bioenergy, Volume 121 (2019) : 99-114

Forest-based bioenergy plays an important role in climate mitigation for limiting global mean temperature increase to below 2 °C. The greenhouse gas(GHG) impact of three forest-based bioenergy systems from the USA, Canadaand Spain supplying wood pellets for electricity in the UK were evaluated by conducting lifecycle assessments and forest carbon modelling of the three forest systems. Cumulative emissions were analysed by calculating the forest carbon stock change and net GHG emissions balance of the forest-based bioenergy electricity. The analysis considered both the replacement of the existing electricity mix with bioenergy electricity and forest management with and without bioenergy use. The supply chain emissions and forest carbon balances indicated that GHG emission reductions are possible. However, the cumulative net GHG balance at forest landscape scale revealed that the reduction potential is limited, potentially with no GHG reductions in fast growing forests with shorter rotations, while slow growing forest systems with longer rotations result in greater GHG reductions. This means that the maximum climate benefit is delivered at a different point in time for different forest systems. To evaluate the climate change mitigation potential of forest-based bioenergy it is therefore necessary to consider the management, utilisation and relevant counterfactual of the whole forest and its products. In terms of climate change mitigation potential and minimising possible negative impacts that would require multi-level governance.

Keywords: Carbon balance; Cumulative emission; Forest bioenergy; Forest management; Greenhouse gas emissions; Lifecycle assessment; Net GHG balance

Nano Biotechnology

Rama RaoKarri[1], **ShahriarShams[2]**, **J.N.Sahu[3]** ([1]Petroleum and Chemical Engineering, Faculty of Engineering, Universiti Teknologi Brunei, Gadong, Brunei[2]Civil Engineering Programme Area, Faculty of Engineering, Universiti Teknologi Brunei, Gadong, Brunei[3]Faculty of Chemistry, Institute of Chemical Technology, University of Stuttgart, Stuttgart, Germany) 4 - Overview of Potential Applications of Nano-Biotechnology in Wastewater and Effluent Treatment. **Nanotechnology in Water and Wastewater Treatment**.Theory and Applications. Micro and Nano Technologies, (2019) : 87-100

A reliable and sustainable supply of water is one of the most basic humanitarian needs and yet remains a challenge to meet global demand. Rivers, lakes, and reservoirs are the primary sources of freshwater and many civilizations evolved around riverine systems due to the availability of ample supply of water and fertile land. With rapid industrial growth, urbanization and increased population, a massive amount of effluents are generated and released into waterbodies which contaminate the water, posing a threat both to human and aquatic lives. The need for scientific innovation to enable sustainable and integrated water management is a step forward for achieving water security. Applications of nanotechnology-based methods are finding many potential solutions in diverse fields, and this technology holds great potential for improving treatment efficiency as well as supplement the water supply from the unconventional water resources. The choice of right nanomaterial, its inherent mechanisms, and its cost-effective methodology increase the efficiency of their applications. In this chapter, nano-based applications, its advantages and limitations are thoroughly reviewed with existing conventional processes, obstacles and constraints for commercialization. In the framework of enormous benefits of biotechnology, nano-biotechnology is evolving with the development of antimicrobial nanomaterials, which has enormous potential applications for pollutants and contaminants removal as illustrated in this chapter.

Keywords: Nano-biotechnology; effluent treatment; nanomaterials; removal of toxic metals; water contamination; nano adsorbents

YuhuaWeng[a], HaihuaXiao[d], JinchaoZhang[c], Xing-JieLiang[b], YuanyuHuang[a]. ([a]Advanced Research Institute of Multidisciplinary Science, School of Life Science, Key Laboratory of Molecular Medicine and Biotherapy, Beijing Institute of Technology, Beijing 100081, PR China[b]Chinese Academy of Sciences (CAS) Key Laboratory for Biomedical Effects of Nanomaterials and Nanosafety, CAS Center for Excellence in Nanoscience, National Center for Nanoscience and Technology of China, Beijing 100190, PR China[c]College of Chemistry & Environmental Science, Chemical Biology Key Laboratory of Hebei Province, Key Laboratory of Medicinal Chemistry and Molecular Diagnosis of the Ministry of Education, Hebei University, Baoding 071002, PR China[d]Beijing National Laboratory for Molecular Sciences, State Key Laboratory of Polymer Physics and Chemistry, Institute of Chemistry, Chinese Academy of Sciences, Beijing 100190, PR China) **RNAi therapeutic and its innovative biotechnological evolution. Biotechnology Advances, (2019)**

Recently, United States Food and Drug Administration (FDA) and European Commission (EC) approved Alnylam Pharmaceuticals' RNA interference(RNAi) therapeutic, ONPATTRO™ (Patisiran), for the treatment of the polyneuropathy of hereditary transthyretin-mediated (hATTR) amyloidosis in adults. This is the first RNAi therapeutic all over the world, as well as the first FDA-approved treatment for this indication. As a milestone event in RNAi pharmaceutical industry, it means, for the first time, people have broken through all development processes for RNAi drugs from research to clinic. With this achievement, RNAi approval may soar in the coming years. In this paper, we introduce the basic information of ONPATTRO and the properties of RNAi and nucleic acid therapeutics, update the clinical and preclinical development activities, review its complicated development history, summarize the key technologies of RNAi at early stage, and discuss the latest advances in delivery and modification technologies. It provides a comprehensive view and biotechnological insights of RNAi therapy for the broader audiences.

Keywords: ONPATTRO; Patisiran; siRNA;RNA interference; siRNA delivery; Chemical modification; Nucleic acid therapeutics; GalNAc; Liposome; Antisense oligonucleotide

GabrielaKratošová[a], VeronikaHolišová[a], ZuzanaKonvičková[b], Avinash P.Ingle[c], SwapnilGaikwad[d], KateřinaŠkrlová[a], AlešProkop[e], MahendraRai[f], DanielaPlachá[ab] ([a]Nanotechnology Centre, VŠB – Technical University of Ostrava, 17. listopadu 15/2172, Ostrava, Czech Republic[b]ENET Centre, VŠB – Technical University of Ostrava, 17. listopadu 15/2172, Ostrava, Czech Republic[c]Department of Biotechnology, Lorena School of Engineering, University of Sao Paulo, Lorena, Brazil[d]Dr. D.Y. Patil Biotechnology and Bioinformatics Institute, Tathawade, Pune, India[e]Chemical Engineering, Vanderbilt University, Nashville, TN 37235, USA[f]Department of Biotechnology, Nanobiotechnology Laboratory, S.G.B. Amravati University, Amravati 444602, Maharashtra, India) **From biotechnology principles to functional and low-cost metallic bionanocatalysts. Biotechnology Advances, Volume 37, Issue 1 (2019) : 154-176**

Chemical, physical and mechanical methods of nanomaterial preparation are still regarded as mainstream methods, and the scientific community continues to search for new ways of nanomaterial preparation. The major objective of this review is to highlight the advantages of using green chemistry and bionanotechnology in the preparation of functional low-cost catalysts. Bionanotechnology employs biological principles and processes connected with bio-phase participation in both design and development of nano-structures and nano-materials, and the biosynthesis of metallic nanoparticlesis becoming even more popular due to; (i) economic and ecologic effectiveness, (ii) simple one-step nanoparticle formation, stabilisation and biomass support and (iii) the possibility of bio-waste valorisation. Although it is quite difficult to determine the precise mechanisms in particular biosynthesis and research is performed with some risk in all trial and error experiments, there is also the incentive of understanding the exact mechanisms involved. This enables further optimisation of bionanoparticle preparation and increases their application potential. Moreover, it is very important in bionanotechnological procedures to ensure repeatability of the methods related to the recognised reaction mechanisms. This review, therefore, summarises the current state of nanoparticle biosynthesis. It then demonstrates the application of biosynthesised metallic nanoparticles in heterogeneous catalysis by identifying the many examples where bionanocatalysts have been successfully applied in model reactions. These describe the degradation of organic dyes, the reduction of aromatic nitro compounds, dehalogenation of chlorinated aromatic compounds, reduction of Cr(VI) and the synthesis of important commercial chemicals. To ensure sustainability, it is important to focus on nanomaterials that are capable of maintaining the important green chemistry principles directly from design inception to ultimate application.

Keywords: Biosynthesis; Nanoparticles; Bionanotechnology; Green chemistry; Catalysis; Pollutants degradation

DamienThiry[a], NathanVinx[a], Fancisco JavierAparicio[b], DavidMoerman[cd], RobertoLazzaroni[cd], DamienCossement[d], RonySnyders[ad] ([a]Chimie des Interactions Plasma-Surface, CIRMAP, University of Mons, Place du Parc 20, B7000 Mons, Belgium[b]Instituto de Ciencia de Materiales de Sevilla (CSIC-Universidad de Sevilla), Seville E-41092, Spain[c]Laboratory for Chemistry of Novel Materials, CIRMAP, University

of Mons, Place du Parc 20, B7000 Mons, Belgium[d]Materia Nova Research Center, Parc Initialis, Avenue Nicolas Copernic 1, B-7000 Mons, Belgium), 2019

This work aims at presenting an innovative method for tailoring the morphology of functionalized plasma polymer films (PPF). The approach is based on the formation of a plasma polymer bilayer system in which the two layers differ by their chemical composition and cross-linking degree. As a case study, propanethiol-based plasma polymer films have been investigated. As revealed by a much higher S/C ratio than in the propanethiol precursor (i.e. 0.83 vs 0.33), it has been demonstrated that the bottom layer contains a large fraction of trapped sulfur-based molecules (e.g. H_2S). When further covered by a denser PPF formed at higher energetic conditions, a three-dimensional morphological reorganization takes place giving rise to the micro/nano structuration of the organic material. The shape, the dimensions as well as the density of the generated structures are found to depend on the thickness of both coatings involved in the bilayer structure, offering a great flexibility for surface engineering. Annealing experiments unambiguously confirm the major role played by the sulfur-based trapped molecules for inducing the reshaping process. The whole set of data clearly paves the way for the development of an innovative approach for finely tailoring the morphology of functionalized PPF at the micro/nano scale.

Keywords: Plasma polymer; Nano-architecture; Bilayer; Substrate temperature

ArdaIşıldar[ab], Eric D.van Hullebusch[ac], MarkusLenz[de] GijsDu Laing[f], AlessandraMarra[g], AlessandraCesaro[g], SandeepPanda[h], AtaAkcil[h], Mehmet AliKucuker[i], KerstinKuchta[i] ([a]IHE Delft Institute for Water Education, Delft, The Netherlands[b]Université Paris-Est, Laboratoire Geomatériaux et Environnement (LGE), EA 4508, UPEM, 77454 Marne-la-Vallée, France[c]Institut de Physique du Globe de Paris, Sorbonne Paris Cité, Universitè Paris Diderot, UMR 7154, CNRS, F-75005 Paris, France[d]Fachhochschule Nordwestschweiz, University of Applied Sciences and Arts Northwestern Switzerland, Brugg, Switzerland[e]Sub-Department of Environmental Technology, Wageningen University, 6700 AA Wageningen, The Netherlands[f]Department of Applied Analytical and Physical Chemistry, Ghent University, Belgium[g]Sanitary Environmental Engineering Division (SEED), Department of Civil Engineering, University of Salerno, Italy[h]Mineral-Metal Recovery and Recycling Research Group, Mineral Processing Division, Department of Mining Engineering, Suleyman Demirel University, TR32260 Isparta, Turkey[i]Hamburg University of Technology (TUHH), Institute of Environmental Technology and Energy Economics, Waste Resources Management, Harburger Schloßstr. 36, 21079 Hamburg, Germany) Biotechnological strategies for the recovery of valuable and critical raw materials from waste electrical and electronic equipment (WEEE) – A review. Journal of Hazardous Materials, Volume 362 (2019) : 467-481

Critical raw materials (CRMs) are essential in the development of novel high-tech applications. They are essential in sustainable materials and green technologies, including renewable energy, emissionfree electric vehicles and energy-efficient lighting. However, the sustainable supply of CRMs is a major concern. Recycling end-of-life devices is an integral element of the CRMs supply policy of many countries. Waste electrical and electronic equipment(WEEE) is an important secondary source of CRMs. Currently, pyrometallurgical processes are used to recycle metals from WEEE. These processes are deemed imperfect, energy-intensive and non-selective towards CRMs. Biotechnologies are a promising alternative to the current industrial best available technologies (BAT). In this review, we present the current frontiers in CRMs recovery

from WEEE using biotechnology, the biochemical fundamentals of these bio-based technologies and discuss recent research and development (R&D) activities. These technologies encompass biologically induced leaching (bioleaching) from various matrices,biomass-induced sorption (biosorption), and bioelectrochemical systems (BES).

Keywords: Biotechnologies; Bioleaching; Biosorption; Bioprecipitation; Critical metals; Electronic waste

BingbingWu[abc1], YuLi[abc1], NanfangNie[bc], JiaqiXu[bc], ChengruiAn[bc], YixiaoLiu[bc], YafeiWang[bc], YishanChen[bc], LinGong[bc], QikaiLi[bc], ElenaGiusto[d], VaritsaraBunpetch[bc], DandanZhang[e], HongWeiOuyang[bcf], XiaoHuiZou[abc] ([a]Clinical Research Center, The First Affiliated Hospital, School of Medicine, Zhejiang University, Hangzhou, Zhejiang, 310003, PR China[b]Zhejiang Provincial Key Laboratory of Tissue Engineering and Regenerative Medicine, Hangzhou, Zhejiang, 310058, PR China[c]Dr.Li Dak Sum & Yip Yio Chin Center for Stem Cell and Regeneration Medicine, Zhejiang University, Hangzhou, Zhejiang, 310003, PR China[d]Institute of Orthopaedics and Musculoskeletal Science, University College London, Stanmore, London, UK[e]Department of Pathology, Zhejiang University, Hangzhou, 310058, PR China[f]Zhejiang University-University of Edinburgh Institute, Hangzhou, 310058, PR China) **Nano genome altas (NGA) of body wide organ responses. Biomaterials, Volume 205 (2019) : 38-49**

Nanoparticles are widely developed and utilized in the pharmaceutical and medicine industry, as they can be easily distributed and infiltrated throughout the whole body once administered; however, the body wide effect of nanoparticles infiltration is still unclear. In this study, we developed a new strategy of Nano Genome Altas (NGA) of multi-tissues to study the acute Body-wide-Organ-Transcriptomic response to nanomaterials. Hydroxyapatite(HA)-Nanoparticles (HANPs) was applied in this study as an example both *in vitro* and *in vivo*. Results showed that the effect of HANPs is organ specific and mainly related to immune responses in spleen and muscle, proliferation in spleen and bone, stress and apoptosis in spleen and PBMC, ion transport in spleen, kidney, and liver tissues, metabolism in heart, spleen, and muscle, as well as tissue specific epigenetic and signal pathways. *In vitro*experiments also confirmed that the effects of HANPs on different tissue stem cells were tissue specific. Thus, Nano Genome Altas can provide a body-wide view of the transcriptomic response of multiple organs and tissue specific stem cells to HANPs; it could also be useful for optimizing HANPs and other nano-delivery systems.

Keywords: Nanoparticle; Genome response; Transcriptomics; Body-wide; Hydroxyapatite

Emerson B.LeePhD[a1], Hyung-MinJeonMS[b1], Chang-UngKimMS[bc], Sang M.ParkMS[b], GeunyoungChoBS[a], Hyun-JinKimMS[b], YoungjinKimPhD[a], Doo-JinKimPhD[bc], Young S.KimPhD[b], HayyoungLeePhD[d], Jie-OhLeePhD[a] ([a]Department of Chemistry, Korea Advanced Institute of Science and Technology, Daejeon, Republic of Korea[b]Department of Biochemistry, College of Natural Sciences, Chungnam National University, Daejeon, Republic of Korea[c]Infectious Disease Research Center, Korea Research Institute of

Bioscience and Biotechnology (KRIBB), Daejeon, Republic of Korea[d]Institute of Biotechnology, Chungnam National University, Daejeon, Republic of Korea) Attachment of flagellin enhances the immunostimulatory activity of a hemagglutinin-ferritin nano-cage. Nanomedicine: Nanotechnology, Biology and Medicine, Volume 17 (2019) : 223-235

Hemagglutinin (HA) displayed on a ferritin nano-cage has been shown to be effective in generating a potent immune response against a broad range of influenza infections. Here, we showed that conjugation of flagellin together with HA to the exterior surface of the ferritin cage greatly enhanced not only the humoral immune response in mice but also antigen-specific T cell responses that include Th1 cytokine secretion. The effect of flagellin remained essentially unchanged when the molar ratio of flagellin to HA was reduced from 1:1 to 1:3. Injection of the ferritin-HA-flagellin cage provided protection against lethal virus challenge in mice. We used a small immunoglobulin fragment V_L12.3 as a convenient method for attaching HA and flagellin to the ferritin cage. This attachment method can be used for rapid screening of a variety of protein cages and nano-assemblies to identify the most suitable carrier and adjuvant proteins for the target antigen.

Key words: Ferritin; Hemagglutinin; Flagellin; Nanoparticles; Influenza; Conjugation

Lakshmi KalyaniRuddaraju[a], Sri Venkata NarayanaPammi[b], Guntuku Girijasankar[c], Veerabhadra SwamyPadavala[a], Venkata Ramana MurthyKolapalli[c] ([a]Department of Pharmaceutics, Shri Vishnu College of Pharmacy, Bhimavaram 534202, India[b]Department of Materials Science and Engineering, Chungnam National University, Daeduk Science Town 34134, Republic of Korea[c]A.U. College of Pharmaceutical Sciences, Visakhapatnam 530003, India) A review on anti-bacterials to combat resistance: from ancient era of plants and metals to present and future perspectives of green nano technological combinations. Asian Journal of Pharmaceutical Sciences, (2019)

In the primitive era, humans benefited partially from plants and metals to treat microbial infections. Later these infections were cured with antibiotics but further suffered from resistance issues. In searching of an alternative, researchers developed an adjuvant therapy but were hampered by spreading resistance. Subsequently, nanoparticles (NPs) were proposed to cease the multi-drug resistant bacteria but were hindered due to toxicity issues. Recently, a novel adjuvant therapy employed metals and botanicals into innovative nanotechnology as nano-antibiotics. The combination of green synthesized metallic NPs with antibiotics seems to be a viable platform to combat against MDR bacteria by alleviating resistance and toxicity. This review focuses on the primitive to present era dealings with bacterial resistance mechanisms, newer innovations of nanotechnology and their multiple mechanisms to combat resistance. In addition, special focus is paid on greener NPs as antibiotic carriers, and their future prospects of controlled release and toxicity study.

Keywords: Antibiotics; Bacterial resistance; Green nanotechnology; Adjuvant therapy; Toxicity

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
24. Biodeterioration & Biodegradation
25. Biodiversity and Conservation
26. Biological Agriculture and Horticulture
27. Biomass and Bioenergy
28. Biomedical and Environmental Sciences
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
46. Current Science
47. Cytotechnology
48. Ecology and Environmental Corner
49. Ecological Engineering
50. Ecotoxicology
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
107. Shaspa
108. The Indian Forester
109. Trends in Biotechnology
110. Water, Air and Soil Pollution
111. World Journal of Biotechnology
112. World Journal of Microbiology and Biotechnology
113. Bio-metallurgy and Hydro-metallurgy
114. Nano Biotechnology

Authors Index