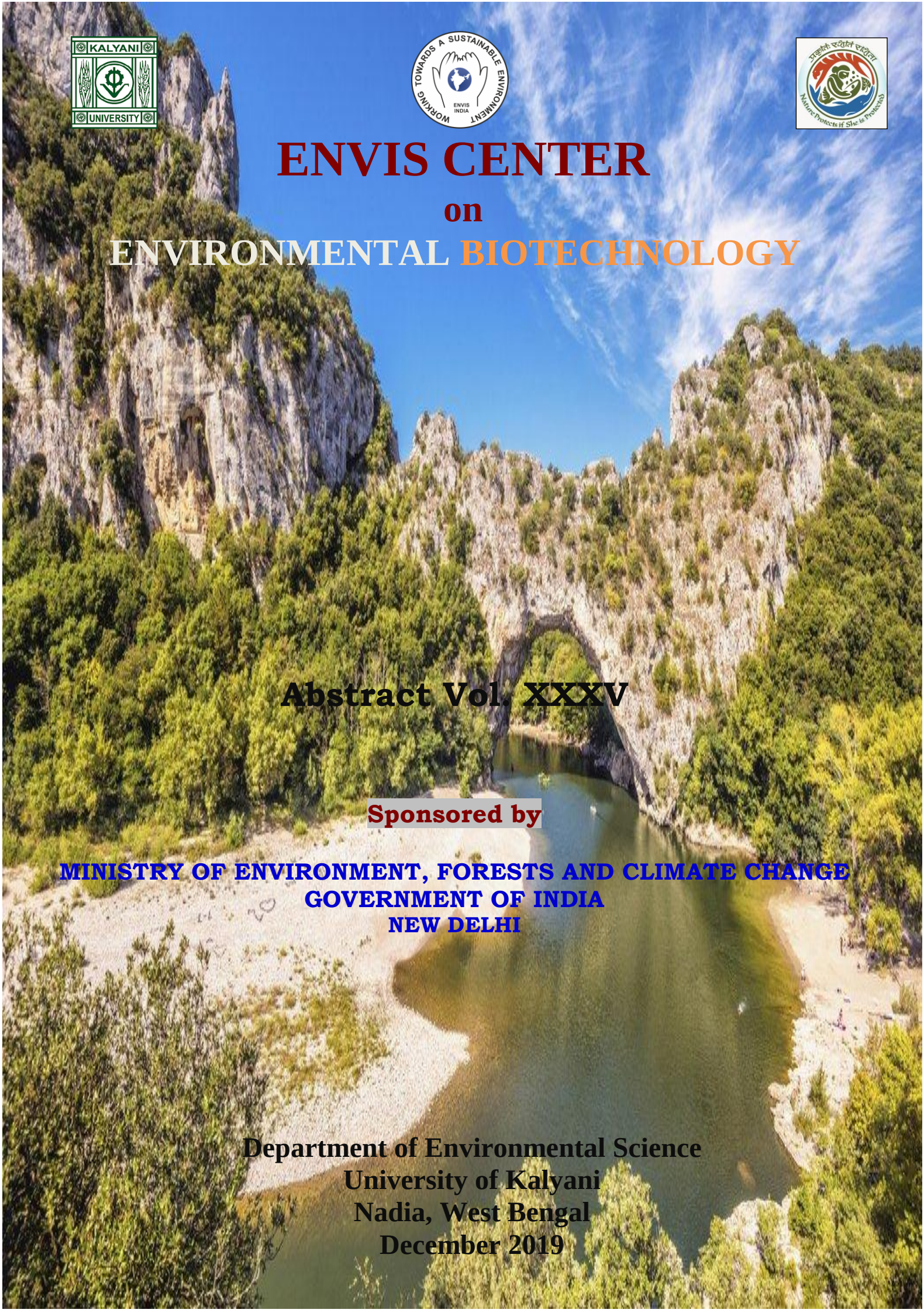

ENVIS CENTER
on
ENVIRONMENTAL BIOTECHNOLOGY

Abstract Vol. XXXV

Sponsored by

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

Department of Environmental Science
University of Kalyani
Nadia, West Bengal
December 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 35th publication of Abstract Volume of this ENVIS Centre. This contains the abstracts of research papers collected from the various areas of Environmental Biotechnology from different journals published in last six months upto December 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 indicates 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 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 broad-based engineering disciplines 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 was 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. Biomasses, 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

Urszula Pankiewicz[a], Małgorzata Góral[a], Katarzyna Kozłowicz[b], Dariusz Góral[b] (a. Department of Analysis and Food Quality Assessment, Faculty of Food Science and Biotechnology, University of Life Sciences in Lublin, Poland, b. Department of Biological Bases of Food and Feed Technologies, Faculty of Production Engineering, University of Life Sciences in Lublin, Poland). **Application of pulsed electric field in production of ice cream enriched with probiotic bacteria (L. rhamnosus B 442) containing intracellular calcium ions. Journal of Food Engineering, Volume 275 (2020): 109876**

Pulsed Electric Field (PEF) with appropriately selected parameters was used to enrich the probiotic L. rhamnosus B 442 strain with calcium ions. Next, six types of ice-cream mixes were prepared and supplemented with 200 µg of calcium ions. Enrichment of 3 variants of mixes: unfermented, lyophilised and fermented, consisted in the addition of bacteria exposed to PEF to increase calcium bioaccumulation. Calcium levels were measured in bacterial cells and ice cream. After 24 h from the production of ice cream their chemical composition, pH, melting rates, and texture were determined. The colour parameters and the total number of microorganisms were analysed as well. The highest accumulation of Ca2+ ions in cells was achieved when the pulsed electric field was applied at the field strength of 3.0 kV/cm and at calcium concentration of 200 µg/mL of medium. The significant differences in all physicochemical parameters that were dependent on the ice cream production process were observed. The use of the PEF-modified L. rhamnosus B 442 bacteria for milk fermentation caused that obtained ice cream had the highest content of dry matter, fat, protein, and carbohydrates, as well as the lowest melting rates. There were no differences in the colour parameters a* and ΔH. Ice cream enriched with calcium ions with the use of PEF did not differ significantly in terms of bacterial survival rates.

Keywords: Pulsed electric field, Ice cream, Calcium bioaccumulation

Yali Shi[ad], Xiaowei Song[ad], Qi Jin[ad], Wenhui Li[ab], Sisi He[ac], Yaqi Cai[ade] (a. State Key Laboratory of Environmental Chemistry and Ecotoxicology, Research Center for Eco-Environmental Science, Chinese Academy of Sciences, Beijing 100085, China, b. Civil and Environment Engineering School, University of Science and Technology Beijing, Beijing 100085, China, c. School of Chemical & Environment Engineering, China University of Mining and Technology, Beijing 10083, China, d. University of Chinese Academy of Sciences, Beijing 100049, China, e. Institute of Environment and Health, Jianghan University, Wuhan 430056, China). **Tissue distribution and bioaccumulation of a novel polyfluoroalkyl benzenesulfonate in crucian carp. Environmental International, Vol 135(2020): 105418**

The emergence of novel per- and polyfluoroalkyl substances (PFASs) has enabled researchers to determine their bioaccumulation, which is important for understanding their internal doses and environmental risks. Here, for the first time, we report on the occurrence of a novel PFAS, p-perfluorous nonenoxybenzenesulfonate (OBS) in wild crucian carp and explore its tissue

distribution and bioaccumulation. The highest levels of OBS were observed in blood (mean/median: 144/133 ng/ml) with the mean tissue/blood ratios (TBRs) consistently below 1, ranging from 0.090 (muscle) to 0.644 (liver). This followed the pattern of perfluorooctane sulfonate (PFOS), implying that their distributions were similar. The calculated tissue-specific LogBAF values, except for muscle, 3.78 (gill)–4.14 (blood) over the regulatory bioaccumulation criterion (Log value: 3.70) indicated its obvious bioaccumulative potency in crucian carp. Molecular docking with estimated binding energies at −8.5 and −9.0 kcal/mol corroborated the strong interactions of OBS with human serum albumin and liver fatty acid binding protein, even though the binding energies were lower than those of PFOS. This, to some extent, explained the lower bioaccumulation of OBS than PFOS. Considering its bioaccumulative potential, large production volume, and wide use, further investigation into the environmental risk and in vivo toxicology of OBS is required.

Keywords: OBS, Tissue distribution, Bioaccumulation factor

Lesly Paradina Fernández[ab], Romina Brasca[abc], Andrés M.Attademo[bd], Paola M.Peltzer[bd], Rafael C.Lajmanovich[bd], María J.Culzoni[ab] (a. Laboratorio de Desarrollo Analítico y Quimiometría (LADAQ), Cátedra de Química Analítica I, Facultad de Bioquímica y Ciencias Biológicas, Universidad Nacional del Litoral, Ciudad Universitaria, 3000, Santa Fe, Argentina, b. Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Godoy Cruz 2290, 1425, Buenos Aires, Argentina, c. Programa de Investigación y Análisis de Residuos y Contaminantes Químicos (PRINARC), Facultad de Ingeniería Química, Universidad Nacional del Litoral, Santiago del Estero 2654, 3000, Santa Fe, Argentina, d. Laboratorio de Ecotoxicología, Facultad de Bioquímica y Ciencias Biológicas, Universidad Nacional del Litoral, Ciudad Universitaria, 3000, Santa Fe, Argentina). Bioaccumulation and glutathione S-transferase activity on Rhinella arenarum tadpoles after short-term exposure to antiretrovirals. Chemosphere Vol. 246(2020): . 125830

The aim of the present study was to investigate the bioaccumulation and toxicological effects of four antiretrovirals (lamivudine, stavudine, zidovudine and nevirapine) on Rhinella arenarum tadpoles, after short-term (48 h) exposure to these drugs at sublethal concentrations. The analytical procedure involved a simple extraction method followed by ultra-high performance liquid chromatography with diode array detection and chemometric analysis for data processing. Under the conditions studied, the analytes investigated, particularly nevirapine, showed possible bioaccumulation in tadpoles. Besides, an increase in the bioaccumulation was observed when increasing the exposure concentration. In addition, the enzymatic biomarkers measured to evaluate the toxicological effects showed that acethylcholinesterase activity was similar to that of the control group, while glutathione S-transferase activity was increased, indicating potential oxidative stress damage. Our results also allowed demonstrating the usefulness of chemometric algorithms to quantitate analytes in complex matrices, such as those absorbed by tadpoles in aquatic ecosystems. The results also evidenced the short-term antiretroviral bioaccumulation in tadpoles and the alteration of antioxidant systems, highlighting the need of environmental studies to elucidate the ecotoxicological risk of antiretrovirals in humans and wildlife.

Keywords: Antiretrovirals, Bioaccumulation, Toxicological biomarkers, TadpolesUHPLC-DAD

Jinlong Zhang[a], Yiting Zeng[a], Bing Liu[b], Xu Deng[a] (a. Shenzhen Key Laboratory of Marine Bioresource and Eco-environmental Science, College of Life Sciences and Oceanography, Shenzhen University, Shenzhen 518060, China, b. School of Traffic and

Environment, Shenzhen Institute of Information Technology, Shenzhen 518172, China). MerP/MerT-mediated mechanism: a different approach to mercury resistance and bioaccumulation by marine bacteria. Journal of Hazardous Materials (2020): 122062

Currently, mechanism underlying mercury resistance and bioaccumulation of marine bacteria remains little understood. A marine bacterium Pseudomonas pseudoalcaligenes S1 is resistant to 120 mg/L Hg2+ with bioaccumulation capacity of 133.33 mg/g. Accordingly; Hg2+ resistance and bioaccumulation mechanism of S1 was investigated at molecular and cellular level. Annotation of S1 transcriptome reveals 772 differentially expressed genes, including Hg2+-relevant genes merT, merP and merA. Both merT and merP gene have three complete copies in S1 genome, while merA gene has only one. In order to evaluate the function of these Hg2+-relevant genes, three recombinant strains were constructed to express MerA (named as A), MerT/MerP (TP) and MerT/MerP/MerA (TPA), respectively. The results show that Hg2+ resistance of strain TP, TPA, and A are improved with minimum inhibition concentration (MIC) being 60 mg/L, 40 mg/L, and 20 mg/L, respectively compared to 2 mg/L of host strain. Strain TP and TPA exhibit enhanced Hg2+ bioaccumulation capacity, while strain A does not differ from the control. Their equilibrium Hg2+ bioaccumulation capacities are 110.48 mg/g, 94.49 mg/g, 83.76 mg/g and 82.29 mg/g, respectively. Summarily, different from most microorganisms that exhibit Hg2+ resistance by MerA-mediated mechanism, marine bacterium S1 achieves Hg2+ resistance and bioaccumulation capability via MerT/MerP-mediated strategy.

Keywords: marine bacteria, mercury, MerT/MerP, MerA, bioaccumulation

Xiaoyan Wang[a], Liping Liu[c], Xiangrui Wang[a], Jinqian Ren[a], Pei Jia[a], Wenhong Fan[ab] (a. School of Space and Environment, Beihang University, Beijing 100191, PR China, b. Beijing Advanced Innovation Center for Big Data-Based Precision Medicine, Beihang University, Beijing 100191, PR China, c. Beijing Center for Disease Prevention and Control, Beijing 100013, China). Influence of humic acid on arsenic bioaccumulation and biotransformation to zebrafish: A comparative study between As(III) and As(V) exposure. Environmental Pollution, Vol. 256 (2020): 113459

Previous studies have indicated that natural organic matter in the aquatic environment could affect arsenic bioaccumulation and biotransformation to aquatic organisms. However, the differences between the effects of arsenite and arsenate exposure have not been studied and compared in fish exposure models. In this study, adult zebrafish (Danio rerio) were exposed to 5 mg/L inorganic as solutions, in the presence of a range of humic acid (HA) concentrations (1, 2.5, 5, 10, 20 mg/L) in 96 h waterborne exposure. Results showed that in the presence of HA, total as bioaccumulation was significantly reduced in zebrafish following arsenite exposure, while this reduction was not observed during arsenate exposure. The reduction in total arsenic bioaccumulation for arsenite exposure can be explained by the fact that HA forming a surface coating on the cell surface, hindering transport and internalization. However, this reduction in total As was not observed due to differences in uptake pathways for arsenate exposure. Results also showed that Arsenobetaine (AsB) was the main biotransformation product in zebrafish following inorganic as exposure, accounting for 44.8%–64.7% of extracted arsenic species in all exposure groups. The addition of HA caused levels of MMA and As (III) to decrease, while the distribution of AsB significantly increased in arsenite exposure groups. The increase in AsB could be because the As(III)-HA complex was formed, affecting the methylation of As(III). In

contrast, the addition of HA to arsenate exposure groups, did not affect the reduction of As(V) to As(III) and therefore, an increase in the distribution of AsB was not observed in arsenate exposure groups. This study provides useful information on the mechanisms of toxicity, for improved risk assessment of As in natural aquatic environments.

Keywords: Arsenic, Humic acid, Zebra fish, Bioaccumulation, Biotransformation

Jun Cai[ab] Chenggang Gu[a], Qingqing Ti[ab], Chang Liu[ab], Yongrong Bian[a], Cheng Sun[c], Xin Jiang[a] (a. Key Laboratory of Soil Environment and Pollution Remediation, Institute of Soil Science, Chinese Academy of Sciences, Nanjing, 210008, PR China, b. University of the Chinese Academy of Sciences, Beijing, 100049, PR China, c. State Key Laboratory of Pollution Control and Resource Reuse, School of the Environment, Nanjing University, Nanjing, 210023, PR China). **Mechanistic studies of congener-specific adsorption and bioaccumulation of polycyclic aromatic hydrocarbons and phthalates in soil by novel QSARs. Environmental Research, Vol. 179, Part B (2019): 108838**

Polycyclic aromatic hydrocarbons (PAHs) and phthalic acid esters (PAEs) which are structurally featured with one or more aromatic skeletons are often regarded as two important groups of organic pollutants due to the widespread distribution and notorious toxic effects in soils. Relative to the great number of structural analogues or congeners detected in soil, however, the soil adsorption and bioaccumulation of PAHs/PAEs by plant is far less studied for the insufficiency of experimental determinations or lack of insights into the inherent structural requirements. To mechanistically evaluate the congener-specific soil adsorption and bioaccumulation for PAHs/PAEs, the quantitative structure-activity relationships (QSARs) were successfully developed by density functional theory (DFT) computation and partial least squares (PLS) analysis. As verified with the higher cumulative variance coefficients and cross-validated correlation coefficients for strong stability, interpretability and predictability, the QSARs could be used for prediction of unknown adsorption potency or bioavailability within the specified applicability domain, respectively. It was indicated by QSAR that the structural requirements of PAHs/PAEs necessary for strengthening the soil adsorption were mainly attributed to the molecular polarizability and the associated dispersion interaction with soil. As regards the bioaccumulation by carrot, the aggravation of spherical polarity change of molecules and the involved electrostatic interaction with soil entity or electron transfer from the highest occupied molecular orbital (HOMO) of PAHs/PAEs was implied to be inherently decisive for the variance of bioavailability among congeners. Based on the holistic view of negative correlation relationship, the soil adsorption seemed to act as the forceful constraint in decreasing the bioaccumulation of PAHs/PAEs and could also be alternatively gauged as the preliminary evaluation of bioavailability and risks on soil ecosystem. It would thus help better understand the soil adsorption and bioaccumulation with the informative mechanistic insights and provide data support for ecological risk assessment of PAHs/PAEs in soils.

Keywords: PAHs, PAEs, Soil adsorption, Bioaccumulation, Quantitative structure-activity relationships

Lulu Zhang[a], Shan Qin[a], Lina Shen[a], Shuangjiang Li[a], Jiansheng Cui[a], Yong Liu[b] (a. College of Environment Science and Engineering, Hebei University of Science and Technology, 050000 Shijiazhuang, Hebei Province, China, b. College of Environmental Science and Engineering, Key Laboratory of Water and Sediment Sciences (MOE), Peking University, 100871 Beijing, China). **Bioaccumulation, trophic transfer, and human health**

risk of quinolones antibiotics in the benthic food web from a macrophyte-dominated shallow lake. North China, Science of Total Environment Vol. 712(2020): 136557

The bioaccumulation and trophic transfer of 12 Quinolones (QNs) have been studied in a macrophyte dominated lake-Baiyangdian Lake, China. QNs concentrations were detected in surface water, sediments, and 25 biological samples. The average concentrations of QNs varied from 3.01 ng/L for Oxolinic Acid (OXO) to 174 ng/L for Flumequine (FLU) in water, 3.28 ng/g (dry weight, dw) for OXO to 97.0 ng/g (dw) for FLU in sediments, and from 2.88 ng/g (dw) for Pipemidic Acid (PIP) to 37.7 ng/g (dw) for FLU in biological samples. The values of bioconcentration factors (BCFs) or bioaccumulation factors (BAFs) (in the range of 98.0–723 L/kg) and biota sediment accumulation factor (BSAFs) (in the range of 0.000300–0.124) were indicated that low bioaccumulation ability of target QNs in biological species. Due to the detected frequencies of FLU, Enrofloxacin (ENR), Norfloxacin (NOR), and Ofloxacin (OFL) were higher than 50%, the trophic magnification factors (TMFs) values for those QNs were calculated from three different habitats. The TMFs for those QNs were ranged from 0.840 to 1.10. Thereinto, ENR and NOR were appeared trophic magnification, while FLU and OFL were appeared trophic dilution in the food web of Baiyangdian Lake. Although the TMFs values of QNs were not showed significantly difference among three habitats, the TMFs values of those QNs showed significantly difference between the foodweb with macrophyte species and without macrophyte species. Except FLU, the other TMFs values of these QNs without macrophyte species (in the range of 0.700–1.01) were lower than the TMFs for QNs with macrophyte species. Finally, the results of human health risk for QNs suggested that consumption of fish from Baiyangdian Lake with a considerable risk, thus more standard and residue limits of QNs should be set to decrease the human health risk around this region.

Keywords: Quinolones (QNs), Bioaccumulation, Trophic transfer, Human health risk, benthic lake foodweb

"x Jianqiang Gu[ab], Xian Chen[c], Yongfeng Wang[ad], Lianhong Wang[a], Katalin Szlavecz[e], Yini Ma[a], Rong Ji[a] (a. State Key Laboratory of Pollution Control and Resource Reuse, School of the Environment, Nanjing University, 163 Xianlin Avenue, Nanjing, 210023, China, b. Key Laboratory of Environmental Engineering, Jiangsu Academy of Environmental Sciences, 176 Jiangdong Beilu Road, Nanjing, 210036, China, c. School of Chemistry and Environmental Engineering, Jiangsu University of Technology, 1801 Zhongwu Avenue, Changzhou, 213001, China, d. Quanzhou Institute for Environmental Protection Industry, Nanjing University, Beifeng Road, Quanzhou, 362000, China, e Department of Earth and Planetary Sciences, The Johns Hopkins University, Baltimore, MD, 21218, USA). **Bioaccumulation, physiological distribution, and biotransformation of tetrabromobisphenol a (TBBPA) in the geophagous earthworm Metaphire guillelmi – hint for detoxification strategy. Journal of Hazardous Materials, Vol. 388 (2020): 122027**

The mechanisms underlying the bioaccumulation and detoxification of tetrabromobisphenol A (TBBPA) by terrestrial invertebrates are poorly understood. We used uniformly ring-14C-labelled TBBPA to investigate the bioaccumulation kinetics, metabolites distribution, and subsequent detoxification strategy of TBBPA in the geophagous earthworm Metaphire guillelmi in soil. The modeling of bioaccumulation kinetics showed a higher biota-soil-accumulation-factor of total 14C than that of the parent compound TBBPA, indicating that most of the ingested

TBBPA was transformed into metabolites or sequestered as bound residues in the earthworms. Bound-residue formation in the digestive tract may hinder the accumulation of TBBPA in other parts of the body. Nonetheless, via the circulatory system, TBBPA was transferred to other tissues, especially the clitellum region, where sensitive organs are located. In the clitellum region, TBBPA was quickly transformed to less toxic dimethyl TBBPA ether and rapidly depurated through feces. We conclude that the detoxification of TBBPA in M. guillelmi occurred via bound-residue formation in the digestive tract as well as the generation and depuration of O-methylation metabolites. Our results provided direct evidence of TBBPA detoxification in earthworms. Further researches are needed to confirm whether O-methylation coupled with depuration is a common detoxification strategy for phenolic xenobiotics in other soil organisms needs to be determined.

Keywords: Geophagous earthworm, Tetrabromobisphenol A, Biotransformation, Bioaccumulation, Detoxification

Bioremediation

Chuanyuan Wang[ab], Shijie He[c], Yanmei Zou[a], Jialin Liu[a], Ruxiang Zhao[d] Xiaonan Yin[d], Haijiang Zhang[d], Yuanwei Li[a] (a. Key Laboratory of Coastal Zone Environment Processes and Ecological Remediation, Yantai Institute of Coastal Zone Research, Chinese Academy of Sciences, Yantai 264003, China, b. Center for Ocean Mega-Science, Chinese Academy of Sciences, Qingdao 266071, China, c. School of Resources and Environmental Engineering, Ludong University, Yantai 264025,China, d. Yantai Oil Spill Response Technical Center of Yantai Maritime Safety Administration, Yantai 264000, China). **Quantitative evaluation of in-situ bioremediation of compound pollution of oil and heavy metal in sediments from the Bohai Sea, China. Marine Pollution bulletin Vol. 150 (2020): 110787**

Owing to the semi-enclosed environment of the Bohai Sea, the ecological effects caused by an oil spill would be significant. A typical in- situ bioremediation engineering project for of oil-spilled marine sediments was performed in the Bohai Sea and a quantitative assessment of the ecological restoration was performed. The bioremediation efficiencies of n-alkane and PAHs in the sediment are 32.84 ± 21.66% and 50.42 ± 17.49% after 70 days of bioremediation, and 60.99 ± 10.14% and 68.01 ± 18.60% after 210 days, respectively. After 210 days of bioremediation, the degradation rates of two- to three ring PAHs and four-ring PAHs are 84.44 ± 23.03% and 26.62 ± 43.76%, respectively. In addition, the concentrations of the heavy metals first increased by 6.00% due to oil spill degradation and release, and then decreased by 72.60% with the degradation of oil caused by bioremediation or vertical migration. According to the continuous tracking monitoring, the composition of the microbial community in the restored area was similar to that in the control area and the clean area in Bohai Sea after 210 days of bioremediation. These results may provide some theoretical and scientific data to understand the degradation mechanism and assessing the ecological remediation efficiency for oil spills in open sea areas.

Keywords: In-situ bioremediation, PAHs, Heavy mental, Sediment Evaluation

Fengmei Li[ab], Shuhai Guo[ab], Bo Wu[ab], Sa Wang[ab] (a. Institute of Applied Ecology, Chinese Academy of Sciences, Shenyang, 110016, China, b. National-Local Joint Engineering Laboratory of Contaminated Soil Remediation by Bio-physicochemical Synergistic Process, Shenyang, 110016, China). **Pilot-scale electro-bioremediation of heavily PAH-**

contaminated soil from an abandoned coking plant site. Chemosphere Vol. 244(2020): 125467

This study presents a systematic pilot-scale study on removal of PAHs from the abandoned site of Shenyang former Coking Plant in China (total PAH concentration of 5635.60 mg kg−1 in soil). Three treatments, including the control treatment (without inoculation and electric field), bioremediation (with inoculation), and the electro-bioremediation (with inoculation and electric field), were conducted with a treatment time of 182 days to assess their PAH-removal efficiency. All the treatments were conducted from May to October under natural conditions. Results show that electro-bioremediation enhanced the removal of total PAHs, especially high-ring (>3 rings) PAHs. At 182 days, the degradation extents of total and 4–6-ring PAHs reached 69.1% and 65.9%, respectively, under electro-bioremediation (29.3% and 44.4% higher, respectively, than those under bioremediation alone). After electro-bioremediation, the total toxicity equivalent concentrations of total PAHs and 4-, 5- and 6-ring PAHs reduced 49.0%, 63.7%, 48.2% and 30.1%, respectively. These results indicate that electro-bioremediation not only effectively removed the PAHs but also reduced the health risks of soil in an abandoned coking plant site. In addition, electro-bioremediation with polarity reversal could maintain uniform soil pH, the degradation extent of PAHs and soil microorganism numbers at all sites. The environmental conditions, such as temperature and rainfall, had little influence on the process of electro-bioremediation. These findings suggest that electro-bioremediation may be applied for field-scale remediation of heavily PAH-contaminated soil in abandoned coking plant sites.

Keywords: Pilot scale, Electro-bioremediation, PAHs, Abandoned sites

Shivani Kumari, Amit, Rahul Jamwal, Neha Mishra, Dileep Kumar Singh (Soil Microbial Ecology and Environmental Toxicology Laboratory, Department of Zoology, University of Delhi, New Delhi, Delhi, 110007, India). Recent developments in environmental mercury bioremediation and its toxicity: A review. Environmental Nanotechnology, Monitoring & Management, Volume 13, (2020): 100283

Mercury (Hg), a global pollutant produced by anthropogenic and natural means acts as a bioacumulative toxin that severely affects our environment and human lives. Besides being a potent neurotoxin, mercury has several adverse effects on all the major body systems. Mercury changes its chemical forms in the environment and travels from place to place and finally it gets deposited deep down into soil and sediments. As mercury remediation through conventional approaches is costly and technically difficult, bioremediation is a more cost-effective, eco-friendly method and accepted by regulatory authorities. This paper emphasizes on the recent developments in the biochemical mechanism of mer operon and its utilization in mercury bioremediation. This review also focuses on the use of mercury resistant bacteria (MRB) for the remediation of mercury-contaminated sites. Furthermore, the role of yeast in mercury bioremediation has also been listed. Moreover, we have focused on the detailed application of whole-cell biosensor, nanotechnology, phytoremediation, plant-assisted microbial remediation and significance of modern biotechnological techniques such as transposon-mediated In-situ molecular breeding (ISMoB) for effective removal of mercury. Conclusively, this review enhances the detailed understanding of mercury bioremediation scenarios on a global scale in recent times.

Keywords: Bioremediation, Mercury, Mercury resistant, bacteria mer operon, Phytoremediation, Toxicity

Hui Chen[a], Qiang Wang[ab] (a. State Key Laboratory of Crop Stress Adaptation and Improvement, School of Life Sciences, Henan University, Kaifeng 475004, China, b. Innovation Academy for Seed Design, CAS, China). **Microalgae-based nitrogen bioremediation. Algal Research, Vol. 46 (2020): 101775**

Pollution poses an increasing threat to the environment and to human health. Nitrogen pollution is of great concern, with nitrogen oxide (NOx) in the air and ammonia nitrogen in water being two major pollutants. Culturing microalgae in NOx or wastewater with high concentrations of ammonia nitrogen would both reduce environmental pollution and provide a source of nitrogen for microalgal culture. However, for microalgae-based bioremediation to be feasible, many fundamental questions about algal biology must be addressed. This review summarizes progress in microalgal biotransformation, outlines applications of this technology, and provides an in-depth description of the current state of microalgae-based bioremediation of NOx or wastewater with high concentrations of ammonia nitrogen. Furthermore, we present possible solutions to some of the obstacles that must be overcome to realize the practical applications of microalgae-based bioremediation.

Keywords: Ammonia nitrogen, Bioremediation, Microalgae, Nitrogen pollutants NOx, Photosynthesis

Rosa Posada-Baquero, María López Martín, José-JulioOrtega-Calvo (Instituto de Recursos Naturales y Agrobiología de Sevilla (IRNAS), C.S.I.C., Avenida Reina Mercedes, 10, E-41012 Seville, Spain). **Implementing standardized desorption extraction into bioavailability-oriented bioremediation of PAH-polluted soils. Science of The Total Environment, Volume 696 (2019): 134011**

We applied a standardized desorption extraction method (Tenax extraction), to assess the bioavailability of native polycyclic aromatic hydrocarbons (PAHs) present in contaminated soils. Single-time point Tenax extraction at 20 h has been recently proposed by the International Organization for Standardization as one of the chemical methods to measure environmental bioavailability of nonionic pollutants (ISO/TS 16751). This work is one of the first ones that use this ISO method systematically in the field of bioremediation, and shows its advantages when used in combination with total concentrations determined with conventional, exhaustive solvent extraction. This method has been applied to different PAHs contaminated soils which had a different level of total PAHs (66–4370 mg kg−1) and which were from different contaminated sites and dissimilar bioremediation approaches. In most samples the study was focused on phenanthrene and benzo(a)pyrene as representative pollutants, although the profile of total PAHs was also studied in some samples. The results from this study show that the pollutant fractions extracted with Tenax during 20 h (D20) decreased after traditional bioremediation (biostimulation and phytoremediation), but they often increased in bioavailability-oriented treatments involving either biosurfactants or bioaugmentation with specialized microbial inocula. Therefore, D20-based assessments provided information on the bioremediation performance, not directly evident through the measurement of total PAH concentrations.

Keywords: Bioavailability, Polycyclic aromatic hydrocarbons, Bioremediation, Desorption extraction

M.Y.Jasmin[a], Fadhil Syukri[a], M.S.Kamarudin[a], Murni Karim[ab] (a. Fish Health Laboratory, Aquaculture Department, Faculty of Agriculture, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia, b. Laboratory of Marine Biotechnology, Institute of Bioscience, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia). Potential of bioremediation in treating aquaculture sludge: Review article. Aquaculture, Volume 519 (2020): 734905

Rapid development in shrimp farming has raised major concerns on the pond effluents that could negatively impact the surrounding ecosystem triggered by the increased of the nutrients input. Sludge is formed due to large quantities of unwanted organic material mainly derived from excess feed and organic degradation. Due to its harmful effect, sludge need to be discharged from the culture ponds frequently. Appropriate treatment is needed before sludge could be discharged to the environment. One of the options that have gain interest of many researchers is through bioremediation process, which has been considered as an environmental friendly method in treating organic waste that does not involve any chemical usage. In this review, toxic components in aquaculture waste are discussed together with the potential of beneficial microbes in bioremediating aquaculture sludge.

Keywords: Bioremediation, Sludge Ammonia, Nitrite Phosphorus, Hydrogen sulfide

Dhiraj Kumar Chaudhary, Jaisoo Kim (Department of Life Science, College of Natural Sciences, Kyonggi University, Suwon, 16227, Republic of Korea) New insights into bioremediation strategies for oil-contaminated soil in cold environments, International Biodeterioration & Biodegradation, International Biodeterioration & Biodegradation, Volume 142, (2019): 58 – 72.

The exploration of petroleum source, production, and transportation in cold environments is increasing tremendously. These activities have made cold regions of the earth vulnerable to oil-contamination. In cold environments, oil-based contaminants persist longer than they do in temperate region because of the low bioavailability of hydrocarbons and the harsh climatic conditions. Oil-based contaminants must be removed to maintain biodiversity and ecological balance. During the last fifteen years, several bioremediation strategies have been employed in cold regions. One effective bioremediation strategy is the introduction of potent cold-adaptive microorganism combining with amendment of physio-chemical parameters into the contaminated sites. However, this approach is still in its infancy compared to the use of mesophilic microorganisms. The current bioremediation practices employed in cold regions suffer with several problems such as lack of potent oil-degraders, poor bioavailability of hydrocarbons, and low temperature, oxygen, and nutrient level. Understanding on these aspects is essential for successful bioremediation in cold environments. This review discusses the current bioremediation strategies, the limiting factors governing bioremediation, and the mechanism of biodegradation in cold regions. Furthermore, culture-independent techniques for assessing potent microbes, laboratory cultivation techniques for isolating psychrophilic oil-degraders and conceptual strategies of bioaugmentation are presented.

Keywords: Bioremediation, Psychrophiles, Cold environments, Bioaugmentation, Enrichment-cultivation

Cristina M.Quintella[abc], Ana M.T.Mata[cd], Leandro C.P.Lima[ce] (a. IQ-UFBA - Chemistry Institute, Federal University of Bahia, Campus de Ondina, R. Barão de Jeremoabo, n. 147, Ondina, Salvador, BA, 40170-115, Brazil, b. CINEA-ESTS-IPS – Centro de Investigação em Energia e Ambiente do Instituto Politécnico de Setúbal, Rua Vale de Chaves, Campus do IPS, Estefanilha, 2910-761, Setúbal, Portugal, c. PROFNIT - Professional Post-Graduate Program in Intellectual Property and Technology Transfer for Innovation, Federal University of Bahia, Campus de Ondina, R. Barão de Jeremoabo, 147, Ondina, Salvador, BA, 40170-115, Brazil, d. IBB – Institute for Bioengineering and Biosciences, Department of Bioengineering, Instituto Superior Técnico, Universidade de Lisboa, Av. Rovisco Pais, 1049-001, Lisboa, Portugal, e. José de Anchieta College, Av. João Durval Carneiro, n. 3039, São João, Feira de Santana, BA, 44051-605, Brazil). Overview of bioremediation with technology assessment and emphasis on fungal bioremediation of oil contaminated soils, Journal of Environmental Management, Volume 241 (2019): 156 – 166.

Environmental contamination is a problem that requires sustainable solutions. Bioremediation technologies have been developed in the last decades and are increasingly used to mitigate environmental accidents and systematic contaminations. A review of bioremediation technologies, based on published article and patent documents, is presented for different types of contaminated matrices, bioremediation agents and contaminants. The worldwide database of the European Patent Office was searched using radicals of keyword as well as the International Patent Classification (IPC) to identify patents in our areas of concern. Technological domains, annual filing volume, legal status, assignee countries and development collaborations are presented and examples are discussed. The total number of patents is compared with the total number of articles. A SWOT analysis for bioremediation technologies is presented. The technologies for water (53%), soils (36%), and sludge (11%) are growing yearly at nearly constant rates. The bioremediation agents are predominantly bacteria (57%), enzymes (19%), fungi (13%), algae (6%), plants (4%) and protozoa. The major contaminants are oils (38%), followed by metals (21%), organic waste (21%), polymers (10%), food (5%), cellulose (5%) and biodiesel. Most of the patents are generally originated from China and United States of America. The soils bioremediation technology of oil is centered on bacteria usage (about two thirds of the articles and patents), being fungi a technology with critical mass and high growth potential. A recent trend in oil bioremediation of soils is the combination of bioremediation agents (fungi and bacteria) in the same process, thus making the process more robust to environment changes.

Keywords: Bioremediation, Technology assessment, Microorganisms, Soils, Waters, Sludge

Biotransformation

Hanna Hamid[a], Loretta Y.Li[a], John R.Grace[b] (a. Civil Engineering, University of British Columbia, 6250 Applied Science Lane, Vancouver, BC V6T 1Z4, Canada, b. Chemical and Biological Engineering, University of British Columbia, 2360 East Mall, Vancouver, BC V6T 1Z3, Canada). Aerobic biotransformation of fluorotelomer compounds in landfill leachate-sediment. Science of The Total Environment (2020): 136547

Consumer products containing fluorotelomer polymers are a source of fluorotelomer compounds to the environment following their disposal at landfills. The fate and transformation of fluorotelomer compounds are unknown in landfill leachates. This study investigates the aerobic biotransformation of 8:2 fluorotelomer alcohols (FTOH) and 6:2 fluorotelomer sulfonate (FTS) in landfill leachate-sediment microcosms using batch tests. Spiked 8:2 FTOH, 6:2 FTS and their

known biotransformation products were quantified in sediment-leachate and headspace over 90 days under aerobic conditions. 8:2 FTOH and 6:2 FTS biotransformation was slow (half-life >>30 d) in landfill leachate-sediment microcosm, suggesting persistence of fluorotelomer compounds under the conditions investigated. Significant volatilization (>20%) of 8:2 FTOH was observed in the microcosm headspace after 90 days. C6 – C8 and C4 – C6 perfluorocarboxylic acids (PFCAs) were the most abundant products for 8:2 FTOH and 6:2 FTS, respectively. PFCAs accounted for 4–9 mol% of the initially spiked parent compounds at 90 day. Perfluorooctanoic acid (PFOA) was the single most abundant product of 8:2 FTOH (>2.8 mol% at 90 days). The unaccounted mass (20 to 35 mol %) of the initially spiked parent compounds indicated formation of fluorotelomer intermediates and sediment-bound residue. Overall the findings suggest that aerobic biotransformation of fluorotelomer compounds acts as a secondary source of long- and short-chain (≤C7) PFCAs in the environment. Partitioning of semi-volatile fluorotelomer compounds (e.g., 8:2 FTOH) to the gas-phase indicates possible long-range transport and subsequent release of PFCAs in pristine environments. Short-chain fluorotelomer replacements (e.g., 6:2 FTS) result in a higher abundance of short-chain PFCAs in landfill leachate. Future research is needed to understand the long-term exposure effects of short-chain PFCAs to humans, aquatic life and biota.

Keywords: Fluorotelomer, Landfill, Leachate, Perfluorocarboxylic, Perfluorooctanoic, Biotransformation

Yeowool Choi[a], Junho Jeon[bc], Younghun Choi[b], Sang Don Kim[a] (a. School of Earth Sciences and Environmental Engineering, Gwangju Institute of Science and Technology, 123 Cheomdangwagi-ro, Buk-gu, Gwangju 61005, Republic of Korea, b. Graduate School of FEED of Eco-Friendly Offshore Structure, Changwon National University, Changwon, Gyeongsangnamdo 51140, Republic of Korea, c. School of Civil, Environmental and Chemical Engineering, Changwon National University, Changwon, Gyeongsangnamdo 51140, Republic of Korea). **Characterizing biotransformation products and pathways of the flame retardant triphenyl phosphate in Daphnia magna using non-target screening. Science of The Total Environment, Volume 708 (2020): 135106.**

Triphenyl phosphate (TPHP), one of the organophosphate flame retardants, has been widely used in manufacturing, thereby causing a gradual increase in TPHP concentrations in aquatic environments. However, the information on the biotransformation mechanism of TPHP in invertebrates is lacking. The study identified the biotransformation products of TPHP in Daphnia magna, which showed particularly high toxicity in aquatic organisms, and determined the rates of depuration. Daphnia magna, a standard species for toxicity studies, was exposed to triphenyl phosphate and transferred to the pure medium. The biotransformation products of TPHP and its depuration rates were determined by liquid chromatography-high resolution mass spectrometry. Nine biotransformation products (five in the positive mode and four in the negative mode) of triphenyl phosphate were identified in D. magna. Based on the depuration ratio, the major biotransformation mechanism is estimated to be cysteine conjugation and sulfation. Certain biotransformation products (diphenyl phosphate, hydroxylated triphenyl phosphate, and thiol triphenyl phosphate) might induce toxicity in biota. The results could be used to predict main biotransformation processes and toxic products of organophosphate flame retardants in aquatic invertebrates.

Keywords: Biotransformation, Triphenyl phosphate, Daphnia magna, High resolution mass spectrometry

AlmandoGeraldi[ab], Ni'matuzahroh[ab], Fatimah[ab], Chang-Hao Cui[c], Thi Thuy Nguyen[d], Sun Chang Kim[cde] (a. Department of Biology, Faculty of Science and Technology, Universitas Airlangga, Surabaya, 60115, Indonesia, b. Research Center for Bio-molecule Engineering, Universitas Airlangga, Surabaya, 60115, Indonesia, c. Intelligent Synthetic Biology Center, Korea Advanced Institute of Science and Technology (KAIST), Daejeon, 34141, South Korea, d. Department of Biological Sciences, Korea Advanced Institute of Science and Technology (KAIST), Daejeon, 34141, South Korea, e. KAIST Institute for BioCentury, Korea Advanced Institute of Science and Technology (KAIST), Daejeon, 34141, South Korea). **Enzymatic biotransformation of ginsenoside Rb1 by recombinant β-glucosidase of bacterial isolates from Indonesia. Biocatalysis and Agricultural Biotechnology, Volume – 23 (2020): 101449.**

B-Glucosidase (EC. 3.2.1.21) is of industrial interest due to its critical role in the utilization of cellulosic biomass to produce high-value chemical compounds and biofuels. Moreover, β-glucosidases can be utilized in the biotransformation of high value plant active materials such as ginsenosides. In this report, we confirmed the biotransformation activity of ginsenosides by β-glucosidases from Bacillus sp. 3 KP and Serratia marcescens LII61 strains isolated from Indonesia. B-Glucosidases from both bacterial strains were cloned and overexpressed in Escherichia coli BL21 (DE3). Crude cell extract of E. coli BL21 (DE3) overexpressing the β-glucosidase were used for the biotransformation of ginsenosides Rb1. Results showed that the Rb1 was biotransformed to the more pharmacologically active rare ginsenosides, gypenoside XVII and F2. This work is the first effort to use β-glucosidases from Indonesian bacterial strains for ginsenosides biotransformation and is expected to encourage further exploration of β-glucosidase-producing bacterial strains from Indonesia.

Keywords: β-glucosidase, Biotransformation, Ginsenosides, Bacillus sp., Serratia marcescens

Shao-Hua Xu[ad], Hai-lan Chen[ad], Yong Fan[b] Wei Xu[a], Jian Zhang[c] (a. College of Pharmacy, Fujian University of Traditional Chinese Medicine, Fuzhou, Fujian 350122, China, b. Novo Nordisk Foundation Center for Basic Metabolic Research, Section of Metabolic Genetics, Faculty of Health and Medical Sciences, University of Copenhagen, Panum, Maersk Tower, Blegdamsvej 3B, Copenhagen N 2200, Denmark, c. State Key Laboratory of Natural Medicines, China Pharmaceutical University, Nanjing, Jiangsu 210009, China). **Application of tandem biotransformation for biosynthesis of new pentacyclic triterpenoid derivatives with neuroprotective effect. Bioorganic & Medicinal Chemistry Letters, Volume 30, Issue 4 (2020): 126947**

Tandem whole-cell biotransformation was applied successfully to deliver novel pentacyclic triterpenoid derivatives for the first time. In this process, the starting substrate oleanolic acid (1) was biotransformed into a hydroxylated metabolite 1a by Rhizopus chinensis CICC 40335 and then was further glycosylated to 1b by Bacillus subtilis ATCC 6633. Moreover, metabolite 1a was furtherly oxidized by Streptomyces griseus ATCC 13273 and generated two new derivatives as 1c and 1d. To validate the feasibility, tandem biotransformation of 18β-glycyrrhetinic acid (2) by R. chinensis and B. subtilis was also conducted and offered a glycosylated derivative (2c). Finally, the neuroprotective effects of the derivatives were assessed on neural injury PC12 cell model induced by cobalt chloride.

Keywords: Tandem biotransformation, Pentacyclic triterpenoid, Structural modification, Neuroprotective

Y.Nor Suhaila[ab], A.Hasdianty[c], N.M.Maegala[ab], A.Aqlima[d], A.Hazeeq Hazwan[ac], M.Rosfarizan[d], A.B.Ariff[d] (a. Institute of Bio-IT Selangor, Universiti Selangor, Jalan Zirkon A7/A, Seksyen 7, 40000, Shah Alam, Selangor, Malaysia, b. Centre for Foundation and General Studies, Universiti Selangor, Jalan Zirkon A7/A, Seksyen 7, 40000, Shah Alam, Selangor, Malaysia, c. Faculty of Science and Biotechnology, Universiti Selangor, Jalan Timur Tambahan, 45600, Bestari Jaya, Selangor, Malaysia, d. Faculty of Biotechnology and Biomolecular Sciences, Universiti Putra Malaysia, 43400, Serdang, Selangor, Malaysia). **Biotransformation using resting cells of Rhodococcus UKMP-5M for phenol degradation. Biocatalysis and Agricultural Biotechnology, Volume 21 (2019): 101309.**

Phenol is a toxic compound that may be transformed into non-toxic compounds by the activity of microbial cells. The possibility of using biotransformation method for the degradation of phenol was studied using the whole cells of Rhodococcus UKMP-5M suspended in 250 mL shake flask with buffered liquid containing phenol. The cells of Rhodococcus UKMP-5M were produced by cultivation in Minimal Salt Medium (MSM) with the addition of phenol and/or glucose as carbon source. The biotransformation conditions to obtain the highest percentage of phenol degradation were as follows; pH 7.4, 0.5 g/L phenol in MSM as biotransformation medium, cells were produced by cultivation in MSM supplemented with 0.5 g/L phenol and the optimal cell concentration was 10%. The phenol degradation rate obtained in biotransformation using Rhodococcus UKMP-5M cells correlated well with phenol hydroxylase activity. The highest percentage of phenol degradation in biotransformation using suspended cells of Rhodococcus UKMP-5M was only up to 89%, which was slightly lower than those obtained in growing cell system (98%).

Keywords: Biotransformation, Phenol hydroxylase, Biodegradation of phenol, Rhodococcus, UKMP-5M

Shuyan Zhao, Bohui Wang, Zhe Zhong, Tianqi Liu, Tiankun Liang, Jingjing Zhan (Key Laboratory of Industrial Ecology and Environmental Engineering (MOE),; School of Ocean Science and Technology, Dalian University of Technology, Panjin, Liaoning, 124221, PR China). **Contributions of enzymes and gut microbes to biotransformation of perfluorooctane sulfonamide in earthworms (Eisenia fetida). Chemosphere, Volume 238 (2020): 124619.**

Perfluorooctane sulfonamide (FOSA) is known as a key intermediate of perfluorooctane sulfonic acid (PFOS) precursors, which can be frequently detected in the environment and biota. FOSA could be bioaccumulated in earthworms from soil, but the contributions of enzymes and gut microbes involved in the biotransformation of FOSA in earthworms have not been identified. Therefore, the effects of enzyme inhibitors and intestinal microflora on biotransformation of FOSA in earthworms were investigated in the present study. FOSA was biotransformed to form PFOS by earthworms obtained from in vivo and in vitro tests. The addition of FOSA had significantly positive effects on cytolchrome P450 (CYP450) and glutathione-s-transferase (GST) activities, suggesting CYP450 and GST are likely involved in the enzymatic

transformation. In addition, both 1-Aminobenzotriazole (ABT) and ezatiostat hydrochloride (TLK199), which were selected to inhibit the CYP and GST enzymes, respectively, demonstrated inhibition effects on biotransformation of FOSA in earthworms with a dose-dependent relationship. However, the concentrations of FOSA weren't changed by the bacteria isolated from worm gut, suggesting that gut bacteria did not contribute to FOSA biotransformation in earthworms. The results of this study confirm that the transformation of FOSA in earthworms is mediated mainly by enzymes rather than by gut microbes.

Keywords: FOSA, Earthworm, Enzyme inhibitor, Gut microbes, Biotransformation

Marco E.Franco, Ramon Lavado (Department of Environmental Science, Baylor University, Waco, TX 76706, USA). Applicability of in vitro methods in evaluating the biotransformation of polycyclic aromatic hydrocarbons (PAHs) in fish: Advances and challenges, Science of The Total Environment, Volume 671, (2019): 685-695

The biotransformation of polycyclic aromatic hydrocarbons (PAHs) and the biochemical mechanisms involved in such process continue to be intensively studied in the fields of environmental science and toxicology. The investigation of PAH biotransformation in fish is fundamental to understand how piscine species cope with PAH exposure, as these compounds are ubiquitous in aquatic ecosystems and impact different levels of biological organization. New approaches are continuously developed in the field of ecotoxicology, allowing live animal testing to be combined with and, in some cases, replaced with novel in vitro systems. Many in vitro techniques have been developed and effectively applied in the investigation of the biochemical pathways driving the biotransformation of PAH in fish. In vitro experimentation has been fundamental in the advancement of not only understanding PAH-mediated toxicity, but also in highlighting suitable cell-based models for such investigations. Therefore, the present review highlights the value and applicability of in vitro systems for PAH biotransformation studies, and provides up-to-date information on the use of in vitro fish models in the evaluation of PAH biotransformation, common biomarkers, and challenges encountered when developing and applying such systems.

Keywords: Biotransformation, In vitro, Fish, Polycyclic aromatic hydrocarbons

Yanyan Jia[ab], Linwan Yin[ab], Samir Kumar Khanal[c], Huiqun Zhang[ab], Akashdeep Singh Oberoi[ab], Hui Lua[b] (a. School of Environmental Science and Engineering, Sun Yat-sen University, Guangzhou, PR China, b. Shenzhen Research Institute of Sun Yat-sen University, Shenzhen, PR China, c. Department of Molecular Biosciences and Bioengineering, University of Hawai‘i at Mānoa, USA). Biotransformation of ibuprofen in biological sludge systems: Investigation of performance and mechanisms. Water Research, Volume 170, (2020): 115303.

Ibuprofen (IBU), a common non-steroidal anti-inflammatory drug (NSAID), is widely used by humans for controlling fever and pain, and is frequently detected in the influent of wastewater treatment plants and different aquatic environments. In this study, the biotransformation of IBU in activated sludge (AS), anaerobic methanogenic sludge (AnMS) and sulfate-reducing bacteria (SRB)-enriched sludge systems was investigated at three different concentrations of 100, 500 and 1000 μg/L via a series of batch and continuous studies. IBU at concentration of 100 μg/L was effectively biodegraded by AS whereas AnMS and SRB-enriched sludge were less effective in IBU biodegradation at all concentrations tested. However, at higher IBU concentrations of

500 and 1000 μg/L, AS showed poor IBU biodegradation and chemical oxygen demand (COD) removal due to inhibition of aerobic heterotrophic bacteria (i.e., Candidatus Competibacter) by IBU and/or IBU biotransformation products. The microbial analyses showed that IBU addition shifted the microbial community structure in AS, AnMS and SRB-enriched sludge systems, however, the removals of COD, nitrogen and sulfur in both anaerobic sludge systems were not affected significantly ($p > 0.05$). The findings of this study provided a new insight into biotransformation of IBU in three important biological sludge systems.

Keywords: Biological wastewater treatment, Pharmaceutical wastewater, Ibuprofen removal, Biotransformation.

Biomarker

Florian Moik[a], Florian Posch[bc], Ella Grilz[a], Werner Scheithauer[d], IngridPabinger[a], Gerald Prager[d], Cihan Ay[ae] (a. Clinical Division of Haematology and Haemostaseology, Department of Internal Medicine I, Comprehensive Cancer Center Vienna, Medical University of Vienna, Vienna, Austria, b. Division of Oncology, Department of Internal Medicine, Comprehensive Cancer Center Graz, Medical University of Graz, Graz, Austria, c. Center for Biomarker Research in Medicine (CBmed Ges.m.b.H.), Graz, Austria, d. Clinical Division of Oncology, Department of Internal Medicine I, Comprehensive Cancer Center Vienna, Medical University of Vienna, Vienna, Austria, e. I.M. Sechenov First Moscow State Medical University (Sechenov University), Moscow, Russia). **Haemostatic biomarkers for prognosis and prediction of therapy response in patients with metastatic colorectal cancer. Thrombosis Research, Volume 187(2020): 9-17.**

Haemostatic activation and hypercoagulability are frequently observed in patients with metastatic colorectal cancer (mCRC), increase risk of venous thromboembolism (VTE) and have been implicated in tumour proliferation and progression. To date, the association of haemostatic biomarkers with oncologic outcomes including overall survival (OS), progression free survival (PFS) and disease control rate (DCR) is incompletely understood.

Within the framework of the Vienna Cancer and Thrombosis Study, a prospective observational cohort study, we conducted an exploratory analysis to investigate the association of six known biomarkers of haemostasis with oncologic outcomes in 99 patients with mCRC prior to chemotherapy initiation.

Patients with high levels of factor VIII activity (FVIII), D-dimer, prothrombin fragment 1 + 2 (F1 + 2) and fibrinogen (defined as levels >75th percentile) had significantly shorter median OS than patients with lower levels. Elevation of four biomarkers was associated with mortality in multivariable analysis, adjusting for age, sex, number of metastatic sites and VTE (hazard ratio [95% CI] for death per doubling of levels: FVIII: 2.06 [1.28–3.30]; sP-selectin: 1.55 [1.07–2.24]; D-dimer: 1.40 [1.18–1.65]; F1 + 2: 1.64 [1.10–2.46]). Patients with elevated levels had numerically shorter median PFS across all markers and disease control rate (DCR) was significantly smaller in those with high levels of FVIII and F1 + 2 (adjusted odds ratio [95% CI] for DCR per doubling of levels: 0.23 [0.09–0.62] and 0.36 [0.16–0.82]) compared to patients with lower levels.

Specific elevated haemostatic biomarkers are associated with higher mortality and partially with worse response to chemotherapy in patients with mCRC.

Abbreviations

ATEarterial thrombotic eventBMIbody mass indexCATS(Vienna-) Cancer and Thrombosis StudyCIconfidence intervalsDCRdisease control rateEGFRepidermal growth factor receptorF1 + 2prothrombin fragment F1 + 2FVIIIcoagulation factor VIIIHRhazard ratioIQRinterquartile-rangemCRCmetastatic colorectal cancerORodds ratioOSoverall survivalPARsProteinase activated receptorsPFSprogression free survivalsP-selectinsoluble P-selectinTFTissue factorVEGFVascular endothelial growth factorVTEvenous thromboembolism.

Keywords: Biomarker, Haemostasis, Metastatic colorectal cancer, Survival, Mortality

Ángel Sánchez-Illana, José David, Piñeiro-Ramos, Julia Kuligowski (Health Research Institute La Fe, Avda. Fernando Abril Martorell, 106, 46026 Valencia, Spain). Small molecule biomarkers for neonatal hypoxic ischemic encephalopathy. Seminars in Fetal and Neonatal Medicine (2020): 101084.

Hypoxic Ischemic Encephalopathy (HIE) is one of the most deleterious conditions in the perinatal period and the access to small molecule biomarkers aiding accurate diagnosis and disease staging, progress monitoring, and early outcome prognosis could provide relevant advances towards the development of personalized therapies. The emergence of metabolomics, the “omics” technology enabling the holistic study of small molecules, for biomarker discovery employing different analytical platforms, animal models and study populations has drastically increased the number and diversity of small molecules proposed as candidate biomarkers. However, the use of very few compounds has been implemented in clinical guidelines and authorized medical devices. In this work we review different approaches employed for discovering HIE-related small molecule biomarkers. Their roles in associated biochemical disease mechanisms as well as the way towards their translation into the clinical practice are discussed.

Keywords: Hypoxic-Ischemic Encephalopathy, metabolomics, biomarkers

Dharani Narendra, John Blixt, Nicola A.Hanania (Section of Pulmonary and Critical Care Medicine, Baylor College of Medicine, Houston, Texas, United States) Immunological biomarkers in severe asthma, Seminars in Immunology, Volume 46, (2019)

Severe asthma is heterogeneous in its clinical presentation, underlying pathophysiology, course and response to therapy. Clinical and physiological assessment of severe asthma is often inadequate in predicting underlying disease mechanisms and or response to medications. With the emergence of novel targeted therapies in severe asthma, the need for reproducible, easily measured biomarkers became obvious but only few are currently available for clinical use. These biomarkers along with the clinical presentation of the patient play an important role in identifying phenotypes and endotypes, predicting the clinical course and prognosis and improving the precision therapeutic approach to asthma.

Keywords: Severe asthma, Biomarkers, Eosinophils, Exhaled nitric oxide, Periostin, IgE, Composite biomarkers, T2 airway inflammation

Suelen Pizzolatto Dalmolin[a], Danielly Bassani Dreon[b], Flavia Valladão Thiesen[c], Eliane Dallegrave[bd] (a. Experimental Research Center, Clinical Hospital of Porto Alegre: Graduate Program in Medical Sciences – Federal University of Rio Grande do Sul, Porto Alegre, Rio Grande do Sul, Brazil, b. Laboratory of Toxicological Research. Graduate Program in Health Sciences - Federal University of Health Sciences of Porto Alegre, Porto Alegre, Rio Grande do Sul, Brazil, c. Health Sciences School, Pontifical Catholic University of Rio Grande do Sul, Porto Alegre, Rio Grande do Sul, Brazil, d. Department of Pharmacosciences - Federal University of Health Sciences of Porto Alegre, Porto Alegre, Rio Grande do Sul, Brazil). Biomarkers of occupational exposure to pesticides: Systematic review of insecticides. Environmental Toxicology and Pharmacology, Volume 75(2020): **DOI: 10.1016/j.etap.2019.103304**

Pesticides are widely used around the world, and rural workers have greater risk of poisoning. The use of biomarkers for insecticides can contribute to the diagnosis and prevention of poisoning.

To identify, in the scientific literature, the biomarkers of occupational exposure to insecticides of different insecticide classes.

The PubMed, Lilacs and Embase databases were analyzed using a systematic search strategy and in accordance with the criteria established by the PRISMA methodology. Articles with information related to the use of biomarkers to identify active ingredients, or insecticide metabolites, or effects on the human biological matrices were analyzed.

A total of 840 studies was found, and 30 met the selection criteria. The search identified 118 results for insecticide biomarkers, of which 45% were of exposure, 42% of effect, and 14% of susceptibility. Additionally, 78 were possible biomarkers, and only 67 confirmed to be different biomarkers for insecticides. Acetylcholinesterase (AChE), butyrylcholinesterase (BuChE) and 3,5,6-trichloro-2-pyridinol (TCP-y), specific for Chlorpyrifos, were among the most common biomarkers identified; however, most metabolites found were non-specific.

Various insecticide biomarkers were mentioned; nonetheless, only a few are specific and used to identify the wide range of insecticides to which farm workers are exposed.

Keywords: Biomarkers, Metabolites, Insecticides, Pesticides, Occupational monitoring

E. CarlosRodriguez-Merchan (Department of Orthopaedic Surgery, La Paz University Hospital, Madrid, Spain). Serological biomarkers in hemophilic arthropathy: Can they be used to monitor bleeding and ongoing progression of blood-induced joint disease in patients with hemophilia? Blood Reviews (2019): 100642

In patients with hemophilia, levels of uCTX-II and sCS846 increase 5 days after joint hemorrhage with respect to the initial value. In other words, in patients with established hemophilic arthropathy, the aforesaid biomarkers of joint tissue damage augment shortly after the first joint hemorrhage. In patients with hemophilia treated on demand, a correlation has been found between magnetic resonance imaging scores and the CS846 biomarker. Patients with hemophilia having more than one joint with advanced arthropathy have shown high levels of

circulating soluble vascular cell adhesion molecule-1 (sVCAM-1). In addition, sVCAM-1 levels in these patients are associated with the severity of hemophilic arthropathy. In patients with hemophilia, cartilage degradation is increased by 25% compared with controls, as measured by some biomarkers (C2M, CTX-II and COMP). Levels of the cartilage degradation enzyme, ADAMTS5, are 10% lower in patients with hemophilia. Bone formation (PINP) is 25% lower in patients with hemophilia, whereas bone resorption (CTXI) is 30% greater. Acute inflammation (hsCRP) is 50% greater, whereas chronic inflammation (CRPM) is 25% lower. The hsCRP/CRPM ratio is 60% higher in patients with hemophilia than in controls. A panel of biomarkers that combines C2M, CRPM and ADAMTS5 can distinguish patients with hemophilia from controls with 85.3% accuracy. No strong correlation between biomarkers and the radiological and physical examination of the joint has been found.

Keywords: Hemophilia, Hemophilic arthropathy, Biomarkers

Rita Khoury[a], EliasGhossoub[b] (a. Department of Psychiatry and Clinical Psychology, Saint George Hospital University Medical Center, Balamand University School of Medicine, Institute for Development and Applied Advocacy and Care/ IDRAAC, Beirut, Lebanon, b. Department of Psychiatry, Faculty of Medicine & The Medical Center, American University of Beirut, Beirut, Lebanon). **Diagnostic biomarkers of Alzheimer's disease: A state-of-the-art review. Biomarkers in Neuropsychiatry, Volume 1,(2019): 100005**

In 2018, there was a recent shift towards a biological definition of Alzheimer's disease (AD), based on biomarkers measured in vivo even before the onset of clinical dementia symptoms. No single biomarker can by itself accurately diagnose AD. A combination of biomarkers assessed through imaging and cerebrospinal fluid (CSF) yields better diagnostic accuracy. Although amyloid PET imaging and CSF levels of amyloid and tau deposits are increasingly used in AD clinical trials to increase diagnostic confidence in enrolled subjects, routine use of these biomarkers in clinical settings is still premature because of the risk of overdiagnosis, increased cost and/or invasiveness of the assessment method. Also, standardization of measures across studies is needed to assure biomarker regulatory approval. Exploring novel biomarkers beyond the amyloid and tau pathologies and their longitudinal change across the AD continnum are important research avenues for the future.

Keywords: Alzheimer's disease, Biomarker, Biofluid, Diagnosis, Imaging, Precision medicine

Douglas DonnellyIII[ab], Phyu P.Aung[c], George Jour[abd] (a. The Ronald O. Perelman Department of Dermatology, New York University School of Medicine, New York, NY, United States, b. Interdisciplinary Melanoma Program, New York University School of Medicine, New York, NY, United States, c. Department of Pathology, Section of Dermatopathology, The University of Texas MD Anderson Cancer Center, Houston, TX, United States, d. Department of Pathology, New York University School of Medicine, New York, NY, United States). **The "-OMICS" facet of melanoma: Heterogeneity of genomic, proteomic and metabolomic biomarkers. Seminars in Cancer Biology, Volume 59(2019): 165-174**

In the recent decade, cutting edge molecular and proteomic analysis platforms revolutionized biomarkers discovery in cancers. Melanoma is the prototype with over 51,100 biomarkers discovered and investigated thus far. These biomarkers include tissue based tumor cell and tumor microenvironment biomarkers and circulating biomarkers including tumor DNA (cf-

DNA), mir-RNA, proteins and metabolites. These biomarkers provide invaluable information for diagnosis, prognosis and play an important role in prediction of treatment response. In this review, we summarize the most recent discoveries in each of these biomarker categories. We will discuss the challenges in their implementation and standardization and conclude with some perspectives in melanoma biomarker research.

Keywords: Seminars in Cancer Biology, Volume 59,(2019, Pages 165-174)

Angelika Hammerer-Lercher[a], Mehdi Namdar[b], Nicolas Vuilleumier[cd] (a. Institute of Laboratory Medicine, Cantonal Hospital Aarau AG, Switzerland, b. Division of Cardiology, Cardiology Center, Geneva University Hospital, Geneva, Switzerland, c. Division of Laboratory Medicine, Diagnostic Department, Geneva University Hospital, Switzerland, d. Department of Internal Medicine Specialities, Medical Faculty, Geneva University, Geneva, Switzerland) **Emerging biomarkers for cardiac arrhythmias. Clinical Biochemistry, Volume 75 (2020): 1-6**

Cardiac arrhythmias are associated with substantial morbidity and mortality. Recent advances in the pathophysiological understanding of cardiac arrhythmia indicate that inflammation, fibrosis, and even autoimmune mechanisms could facilitate the development of arrhythmias by interfering either with fibroblast activation-related electrical remodeling or with the function of different cardiac ion channels, leading to the emerging concepts of autoimmune and inflammatory channelopathies. In this descriptive review, we considered recent data of the literature focusing on biomarkers reflecting the degree of inflammation, myocardial stretch, fibrosis and sustained B-cell activation as potential additional diagnostic, risk stratification tools and potential therapeutic targets in cardiac arrhythmia.

Keywords: Biomarkers, Cardiac arrhythmias, Inflammation, Fibrosis Autoimmunity

Biofertilizer

Shu Zhao[ab], WenjuanWei[a], Guihong Fu[a], Junfang Zhou[a], Yuan Wang[a], Xincang Li[a], Licai Ma[ac], Wenhong Fang[a] (a. Key Laboratory of Oceanic and Polar Fisheries, Ministry of Agriculture and Rural Affairs, East China Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences, Shanghai, 200090, China, b. Advanced Institute of Translational Medicine, Tongji University, Shanghai, 200092, China, c. Beijing Advanced Innovation Center for Food Nutrition and Human Health, College of Veterinary Medicine, China Agricultural University, Beijing, China). **Application of biofertilizers increases fluoroquinolone resistance in Vibrio parahaemolyticus isolated from aquaculture environments. Marine Pollution Bulletin, Volume 150 (2020): 110592**

Antimicrobial resistance genes in aquaculture environments have attracted wide interest, since these genes pose a severe threat to human health. This study aimed to explore the possible mechanisms of the ciprofloxacin resistance of Vibrio parahaemolyticus (V. parahaemolytiucs) in aquaculture environments, which may have been affected by the biofertilizer utilization in China. Plasmid-mediate quinolone resistance (PMQR) genes, representative (fluoro) quinolones (FNQs), and ciprofloxacin-resistance isolates in biofertilizer samples were analyzed. The significantly higher abundance of oqxB was alarming. The transferable experiments and

Southern blot analysis indicated that oqxB could spread horizontally from biofertilizers to V. parahaemolyticus, and two (16.7%) trans-conjugants harboring oqxB were provided by 12 isolates that successfully produced OqxB. To the best of our knowledge, this study is the first to report PMQR genes dissipation from biofertilizers to V. parahaemolyticus in aquaculture environments. The surveillance, monitoring and control of PMQR genes in biofertilizers are warranted for seafood safety and human health.

Keywords: PMQR genes, Biofertilizer application, Horizontal transfer, Vibrio parahaemolyticus, Environmental health

Shida Ji[bc], Zhihua Liu[b], Bin Liu[a], Yucheng Wang[b], Jinjie Wang[a] (a. State Key Laboratory of Tree Genetics and Breeding (Northeast Forestry University), 26 Hexing Road, 150040 Harbin, People's Republic of China, b. College of Forestry, Shenyang Agricultural University, No. 120 Dongling Road, Shenhe District, Shenyang City 110866, People's Republic of China, c. Key Laboratory of Biogeography and Bioresource in Arid Land, Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences, 818 Beijing South Road, Urumqi, People's Republic of China). **The effect of Trichoderma biofertilizer on the quality of flowering Chinese cabbage and the soil environment. Scientia Horticulturae, Volume 262(2020): 109069**

In the present study, four Trichoderma species were isolated and made into a biofertilizer. Following treatment with the biofertilizer for 30 days, the germination rate (↑22.5%), height (↑24.4%), fresh weight (↑41.7%), and yield (↑37.4%) of flowering Chinese cabbage increased markedly compared with those of the control. In addition, the contents of soluble sugar (2.044%), soluble protein (5.938 %), and chlorophyll (2.803 mg/g) were higher in flowering Chinese cabbage treated with the biofertilizer for 30 days, compared to the control (1.7.4%, 5.611% and 2.639 mg/g respectively); however, the content of nitric nitrogen, with toxicological consequences for human health, was lower (↓23.6%), indicating that Trichoderma could also improve the quality of flowering Chinese cabbage. After Evans blue and Nitro blue tetrazolium staining, the leaves of flowering Chinese cabbage treated with the biofertilizer showed a smaller blue area than in the control, suggesting that the biofertilizer enhanced the tolerance of flowering Chinese cabbage to environment stresses. Furthermore, the biofertilizer contributed to the increasing of soil enzyme activity at 30th days, including urease (↑25.1%), phosphatase (↑13.1%), and catalase (↑14.0%), providing more inorganic N and P to the soil and reducing the harm done to flowering Chinese cabbage by reactive oxygen species. Taken together, the results showed the Trichoderma biofertilizer enhanced the nutrient uptake and tolerance environment stresses, further improving the quality and production of flowering Chinese cabbage.

Keywords: Trichoderma, Brassica campestris, Growth, Soil improvement, Biofertilizer

Yabing Gu[a], Delong Meng[a], Sheng Yang[b], Nengwen Xiao[c], Zhenyu Li[a], Zhenghua Liu[a], Liangzhi Li[a], Xiaoxi Zeng[d], Songrong Zeng[e], Huaqun Yin[a] (a. School of Minerals Processing and Bioengineering, Central South University, Changsha, 410083, China, b. School of Energy Science and Engineering, Central South University, Changsha, 410083, China, c. State Key Laboratory of Environmental Criteria and Risk Assessment, Chinese Research Academy of Environmental Sciences, Beijing, 100012, China, d. College of Life Sciences and Chemistry, Hunan University of Technology, Zhuzhou, 412007, China, e. Yingdong College of Life Sciences, Shaoguan University, Shaoguan, 512005, China).

Invader-resident community similarity contribute to the invasion process and regulate biofertilizer effectiveness. Journal of Cleaner Production, Volume 241(2019): 118278

Biofertilizer application was a sustainable and environment friendly method to improve soil fertility. However, the complexity of soil and environment makes it difficult for microbial colonization and increase the uncertainties of biofertilizer application. Thus, further understanding of the resistance from resident community, invasiveness of biofertilizer and assemble process of soil community is necessary to improve the effectiveness of biofertilizers. Here, three potassium solubilizing biofertilizers with similar function but different similarity with resident soil community (including phylogenetic distance, community composition and diversity) were introduced to field soil at Yongan, Hunan Province, China. The results showed that potassium solubilizing efficiency, structure and composition of soil bacterial community were affected by biofertilizer introductions. Among the three tested biofertilizers, DW had the highest similarity with CK, and the shifts of community structure, composition and network structure in FDW were greater from CK than FCY and FDS. However, the potassium solubilizing efficiency of FDW was lowest among three treatments, which was different from the community shifts. This demonstrated that the similarity between invader-resident communities would affect the resistance from resident community and the chance for alien species to occupy ecological niche, and then affect the invasion effect. Finally, higher community similarity with resident community would make biofertilizer face more intensely resistance and make the potassium solubilizing species in biofertilizer more difficult to spread and grow in new habitat although more species could successful colonization. These results highlight the importance of considering similarity between invader-resident community on the microbial invasion, and provide a potential and economically way to promote the sustainable development of agriculture.

Keywords: Biofertilizer, Sustainable agriculture, Ecological function, Microbial invasion, Community similarity.

Sonam Paliya[ac], Ashootosh Mandpe[bc], Sunil Kumar[c], M. Suresh Kumar[c] (a. Rajiv Gandhi National Research Fellow, Academy of Scientific and Innovative Research (AcSIR), Ghaziabad, 201 002, India, b. Dr. B.R. Ambedkar National Research Fellow, Academy of Scientific and Innovative Research (AcSIR), Ghaziabad, 201 002, India, c. CSIR-National Environmental Engineering Research Institute (CSIR-NEERI), Nehru Marg, Nagpur, 440 020, India). **Enhanced nodulation and higher germination using sludge ash as a carrier for biofertilizer production. Journal of Environmental Management, Volume 250(2019): 109523**

Sludge ash, a byproduct resulting from the combustion of the dewatered sludge generated in the sewage treatment plants, is recognized as a hazardous solid waste throughout the world. This solid waste, which is produced in behemoth volume, has very limited applications and is directly disposed to landfills. The present study aims to explore a novel strategy for utilizing this solid waste for the development of Rhizobium biofertilizer and thus reducing the burden on landfills. The Rhizobium inoculum was prepared and mixed with sludge ash to formulate Rhizobium biofertilizer, and shelf life of this formulation was evaluated by counting colony forming unit. The prepared formulation was applied on lentil seeds, and its effect was analyzed by assessing the plant growth along with other yield characteristics. Enhanced colony forming unit count

(6487.78) was observed in sludge ash carrier combination with a better shelf life of five months in comparison to lignite carrier formulation from the beginning of the experiment (9.1%) till 150th day (69.8%). Lentil seeds treated with sludge ash based biofertilizer showed luxuriant growth with 19% enhanced root length, 42% in number of nodules, 10% in plant growth and 53.40% in seed yield as compared to conventional lignite formulations. Hence, biofertilizer produced from waste material sludge ash is not supposed to cause a hazard for the soil and plants when incorporated in defined amount and can prove to be a substitute for conventional lignite carrier in biofertilizer production.

Keywords: Sludge ash, Biofertilizer, Rhizobium, Lentil, Micronutrients, Lignite

Rahil Khajeeyan[a], Amin Salehi[a], Mohsen Movahhedi Dehnavi[a], Hooshang Farajee[a], Mohammad Amin Kohanmoo[b] (a. Department of Agronomy and Plant Breeding, Faculty of Agriculture, Yasouj University, Yasouj, Iran, b. Department of Plant Breeding and Production Engineering, Faculty of Agriculture and Natural Resource, Persian Gulf University, Boushehr, Iran). Physiological and yield responses of Aloe vera plant to biofertilizers under different irrigation regimes. Agricultural Water Management, Volume 225,(2019): 105768

Aloe vera (Aloe barbadensis Miller) is one of the most important medicinal plants with high resistance to drought, whose tolerability can be promoted using biofertilizers. The purpose of this study was to determine the influence of biofertilizers on some physiological traits and leaf fresh weight of Aloe vera under different irrigation regimes. The experiments were conducted in a research field in Iran (Boushehr with warm and dry climate) during 2016-2018. Irrigation treatments included 25, 50, 75 and 100% of water requirement and the applied biofertilizers treatments were mycorrhizal fungi (MF) (Glomus mosae), phosphate solubilizing bacteria (PSB) (including Pseudomonas putida strain P13 and Pantoea agglomerans strain P5), MF + PSB, and control (without any biofertilizers). The results of three harvests showed advantages of biofertilizers (specially the combination of MF and PSB) utilization on all determined factors such as total chlorophyll and carotenoid contents, leaf proline, and soluble sugar amount. The highest yield was obtained in full irrigation, but due to the absence of significant difference in leaf fresh weight of this treatment with 50% irrigation, as well as the water deficit in Boushehr, located in semi-arid region, 50% irrigation and combination of MF and PSB biofertilizers is recommended. Therefore, Aloe vera is an acceptable option for planting in Boushehr province according to its scant water consumption.

Keywords: Aloe vera, Biofertilizer, Chlorophyll, Irrigation regime, Leaf fresh weight, Proline

Selvakumari Arunachalam, Timothy Schwinghamer, Pierre Dutilleul, Donald L.Smith (Department of Plant Science, McGill University, 21111 Lakeshore Road, Ste-Anne-de-Bellevue, Québec, H9S 3H6, Canada), Heterogeneous causal relationships between plant growth variables for biofertilized field-grown hard red spring wheat (Triticum aestivum [L.]), Field Crops Research, Volume 240(2019): 69-77

The experimental hard red spring wheat (Triticum aestivum [L.]) cultivars AC Barrie, Cardale, Superb, and Vesper are adapted to the wheat-growing regions of the Canadian Prairies. They were bred to resist diseases, but their response to a biofertilizer that is a consortium of bacteria (Bacillus subtilis, Candida utilis, Lactobacillus casei, L. helveticus, L. plantarum, L. rhamnosus, Lactococcus lactis, Rhodopseudomonas palustris-1, and R. palustris-2), filamentous fungi

(Aspergillus oryzae and Candida utilis), and yeast (Saccharomyces cerevisiae) was not known. The objectives of this research were to model the structures of causal relationships between plant variables using a member of the family of structural-equation modelling tools, called path analysis; to calculate the rate of "biofertilization" that would optimize wheat grain yield; and to model the effect of the experimental treatments on wheat yield over sites in Québec, Manitoba, Saskatchewan, and Alberta (Canada). The path models, presented in diagrams depicting heterogeneous structures, indicated that the variability of the wheat harvest index in Ste-Anne-de-Bellevue, Québec, depended on the experimental biofertilizer and dry weight at maturity in 2015; and biofertilizer and dry weight at the vegetative stage in 2016. The variability of plant height at maturity in Ste-Anne-de-Bellevue, Québec, depended on the biofertilizer, dry weight at the vegetative stage and dry weight at maturity in 2015, and dry weight at the vegetative stage and yield in 2016. The covariance between seedling emergence and the height of the primary stem at the vegetative stage of plant development was consistently zero, meaning structural independence for these variables. The ultimate effect of the biofertilizer on yield was positive in Manitoba and Saskatchewan, and positive and statistically significant in 2015 on Chateauguay clay loam at the Québec site. Results also indicated that a biofertilizer formulation free of cellular material inhibited yield from T. aestivum cv. Superb in Alberta. A quadratic model indicated that at the 2016 Québec site, the optimal application rate of the experimental biofertilizer was 356 mL ha−1, in addition to 2 L of commercially available nutrient fertilizer ha−1. These rates of biofertilization and nutrient fertilization are based on results with AC Barrie that was grown under cool spring conditions.

Keywords: Wheat (Triticum aestivum),Path modelling, Causation, Biofertilizer

Divjot Kour[a], Kusam Lata Rana[a], Ajar Nath Yadav[a], Neelam Yadav[b], Manish Kumar[c], Vinod Kumar[d], Pritesh Vyas[a], Harcharan Singh Dhaliwal[a], Anil Kumar Saxena[e] (a. Department of Biotechnology, Dr. Khem Singh Gill Akal College of Agriculture, Eternal University, Baru Sahib, Sirmour, 173101, India, b. Gopi Nath P.G. College, Veer Bahadur Singh Purvanchal University, Ghazipur, 275201, Uttar Pradesh, India, c. Amity Institute of Biotechnology, Amity University, Gwalior, 474005, India, d. Biochemistry, Forage Section, College of Agriculture, CCS, Haryana Agricultural University, Hisar, Haryana, 125004, India, e. ICAR-National Bureau of Agriculturally Important Microorganisms, Kusmaur, 275103, Mau, India). **Microbial biofertilizers: Bioresources and eco-friendly technologies for agricultural and environmental sustainability. Biocatalysis and Agricultural Biotechnology, (2019): 101487**

Biofertilizers consists of the microorganisms bringing about the improvement of the nutrients of the soil enhancing their accessibility to the crops. Plant nutrients form the most vital components of the sustainable agriculture. Producing healthy crops for the fulfillment of the demands of the world's growing population is completely dependent upon kind of the fertilizers being used to provide the plants with all the major nutrients but more dependability on the chemical fertilizers is destroying the environmental ecology and negatively influencing the health of humans. Thus, using microbes as bioinoculants is believed to be the best substitute of chemical fertilizers as eco-friendly manner for plant growth and soil fertility. These microbes are known to be the potent tool to provide substantial benefits to crops for sustainable agriculture. The beneficial microbes colonize the plant (epiphytic, endophytic and rhizospheric) systems of crops and plays

significant role in nutrient uptake from surrounding ecosystems of plants. The plant associates microbes have ability to promote growth of plant under the natural as well as extreme conditions. These plant growth promoting microbes (PGPM) enhance the plant growth by various direct and indirect PGP mechanisms such as biological nitrogen fixation, the production of various plant growth hormones, siderophores, HCN, various hydrolytic enzymes and solubilization of potassium, zinc, and phosphorus. Extensive work on the biofertilizers has been done and even available which clearly reveals that these microbes possess the potential of providing the vital nutrients to the crops in adequate quantities for the enrichment of yield of the crops without disturbing the environment.

Keywords: Biodiversity, Biofertilizers, Bioresources, Plant growth promotion, Sustainable agriculture.

Meng Wang[a], Shibao Chen[a], Yun Han[a], Li Chen[b], Duo Wang[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

Biocomposting

Chengjun Pu, Yao Yu, Jianxiong Diao, Xiaoyan Gong, Ji Li, Ying Sun (Beijing Key Laboratory of Farmland Soil Pollution Prevention and Remediation, College of Resources and Environmental Science, China Agricultural University, Beijing 100193, China), **Exploring the persistence and spreading of antibiotic resistance from manure to biocompost, soils and vegetables, Science of The Total Environment, Volume 688 (2019): 262-269**

The main avenue in which antibiotic resistance enters soils is through the application of livestock manure. However, whether antibiotic resistant bacteria (ARB) and antibiotic resistance genes (ARGs) persist and spread to vegetables with the application of manure and manure products is still unclear. This study assessed seven kinds of cultured ARB, 221 ARGs subtypes and three transposon genes in the vegetable production chain (from manure to biocompost, soils and vegetables). Results showed that at least 80% of ARB, ARGs and transposon genes were removed after aerobic composting. However, aerobic composting did not reduce the diversity of ARGs in pig and chicken manure. A total of 19 ARGs subtypes still persisted during aerobic composting. Compared to the temperature-thermophilic stage, the number of bacteria resistant to erythromycin, the relative abundance of ARGs and IS613 increased 1.7–4.9 times at the temperature-decreasing stage. Direct application of biocompost introduced 11 ARGs subtypes to pakchoi, but these ARGs did not present in biocompost-amended soil. A transposon gene tnpA was also detected in the biocompost-amended soil, but surprisingly was found in the control vegetable. This demonstrated that the transposon gene is intrinsic in pakchoi. Bacterial community analysis and network analysis revealed that a specific genus Terrisporobacter carrying tetO, tetW ermB and tnpA persisted in the vegetable production chain, which may generate a potential risk in the following production. Our study illuminates the persistence and spreading of antibiotic resistance in the vegetable production chain which could help manage the ecological risks arising from antibiotic resistance in manure sources.

Keywords: Antibiotic resistant bacteria, Antibiotic resistance genes, Persistence, Spreading, Vegetable production chain

Biopesticide

Lalit R.Kumar, Adama Ndao, Jose Valéro, R.D.Tyagi (INRS Eau, Terre et Environnement, 490, rue de la Couronne, Québec G1K 9A9, Canada). **Production of Bacillus thuringiensis based biopesticide formulation using starch industry wastewater (SIW) as substrate: A techno-economic evaluation. Bioresource Technology, Volume 294 (2019) 122144**

In this study, cost simulation was made to produce Bacillus thuriengiensis based biopesticide formulation using starch industry wastewater (SIW) as substrate. The results obtained at pilot plant (2000L capacity fermenter) were used for cost simulation of the process. The unit production cost for annual production of 5 million L of formulated biopesticide (20.2 Billion International Units (BIU)/L) was estimated to be $ 2.54/L, which is competitive to chemical pesticides. The techno-economic evaluation revealed that the profitability of the biopesticide manufacturing process was sensitive to the plant capacity and selling price of the biopesticide. The manufacturer should target 5 million L annual plant capacity and selling price of $ 15/L for payback period to be less than 5 years. The process serves many advantages (1) alternate disposal or bio-valorisation of industry wastewater and (2) use of industry wastewater as inexpensive carbon source reducing cost of raw materials for fermentation.

Keywords: Bio pesticide, Bacillus thuringiensis, Starch industry wastewater (SIW), Economic evaluation, Profitability analysis.

Chetan Keswani, Hagera Dilnashin, Hareram Birla, Surya Pratap Singh (Chetan Keswani, Hagera Dilnashin, Hareram Birla, Surya Pratap Singh). Regulatory barriers to Agricultural Research commercialization: A case study of biopesticides in India. Rhizosphere, Volume 11(2019): DOI:10.1016/j.rhisph.2019.100155

Since the Indian green revolution in agriculture, the intensification of pesticide uses has brought into focus the long-term hazardous impact of such practices to public health and the environment. To ensure sustainable long term food security, India is trying to shape a second green revolution with alternative technologies that are ecofriendly to reduce the nefarious environmental impacts. Application of microorganisms of agricultural importance for sustainable crop production and disease management is an effective strategy for replacing conventional agrochemicals. These have been variously called plant growth promoting bacteria (PGPB) or rhizobacteria (PGPR), with biofertilizer and biopesticide properties. Yet, despite two decades of intensive research by universities and the private sector, and the accumulation of countless potentially beneficial microbes across India, there has as yet not been any transforming discoveries or commercialization. Several regulatory and commercialization barriers causing slow market growth and poor acceptance of biopesticides in India are discussed here

Keywords: Biopesticides, Bioinoculants, Biofertilizers, Research development, Sustainable agriculture.

Alireza Neshani[abc], Abbas Tanhaeian[d], Hosna Zare[abc], Mohammad Reza Akbari Eidgahi[e], Kiarash Ghazvini[ab].(a. Antimicrobial Resistance Research Center, Mashhad University of Medical Sciences, Mashhad, Iran, b. Department of Microbiology and Virology, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran, c. Student Research Committee, Mashhad University of Medical Sciences, Mashhad, Iran, d. Department of Plant Protection, Faculty of Agriculture, Shahrood University of Technology, Shahrood, Iran, e. Biotechnology Research Center, Semnan University of Medical Sciences, Semnan, Iran). Preparation and evaluation of a new biopesticide solution candidate for plant disease control using pexiganan gene and Pichia pastoris expression system. Gene Reports, Volume 17(2019): 100509

Annually, plant diseases caused by microbial agents make serious losses in agriculture. Chemical pesticides have been traditionally used to combat such pathogens. However, due to the environmental issues and increased resistance of pathogens in recent years, finding newer agents with higher safety is required. Antimicrobial peptides are one of the fields that recently been considered in this regard. The cheap production of these peptides can pave the way for further research and commercialization. For this purpose, the nucleotide sequence of pexiganan antimicrobial peptide which has lethal effect on a wide range of microbial pathogens was chemically synthesized and cloned in the pPIC9 vector after optimization. The vector was then transformed into the Pichia pastoris GS115. Finally, this new yeast strain was used for the production of biopesticide solution. Then, antimicrobial efficiency was evaluated on 8 plant pathogens and 2 human pathogens. The results showed that antimicrobial activity of this biopesticide was >500 times stronger than the copper compounds on plant pathogens. It was also observed that the lethal effect was higher on plant pathogens than human pathogens. Regarding the natural origin, excellent antimicrobial effect, and also appropriate stability, this biopesticide solution can be used as a new candidate to control plant diseases.

Keywords: Biopesticide, Plant, Antimicrobial peptide, Resistance, Expression, Pichia pastoris

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

Biodegradation

Xia Zhao[ab], Ling Chen[a], Hongrui Ma[c], Jianzhong Ma[d], Dangge Gao[d] (a. College of Chemistry and Chemical Engineering, Shaanxi University of Science & Technology, Xi'an, 710021, China, b. Shaanxi Key Laboratory of Chemical Additives for Industry, Shaanxi University of Science & Technology, Xi'an, 710021, China, c. College of Environmental Science and Engineering, Shaanxi University of Science & Technology, Xi'an, 710021, China, d. College of Bioresources Chemistry and Materials Engineering, Shaanxi University of Science & Technology, Xi'an, 710021, China). **Effective removal of polymer quaternary ammonium salt by biodegradation and a subsequent Fenton oxidation process. Ecotoxicology and Environmental Safety, Volume 188, (2020): 109919**

In this paper, a process combining biodegradation and Fenton oxidation was proposed for the removal of polydiallyldimethylammonium chloride-acrylic-acrylamide-hydroxyethyl acrylate (PDM) in aqueous phase. Biodegradation of PDM was investigated in activated sludge systems, and the effects of the solution pH, mixed liquid suspended solids (MLSS), salinity, co-substrate, and initial substrate concentration, were studied. The biodegradation process was well-described with the Monod model and the values of the kinetics parameters vmax, ks were 0.05 h−1 and 333 mg/L. The optimal biodegradation conditions in the experimental range were determined to be: pH = 7.0, 0%–0.01% (w/v) NaCl, 4000 mg/L of MLSS, and 500 mg/L of glucose as co-substrate. FT-IR analysis indicated that PDM molecules biodegradation partly. The microbial community structures and dehydrogenase activity analysis revealed that PDM showed some toxicity to microorganisms in activated sludge. The effects of several parameters, including the

pH and chemical doses, were investigated for removing PDM in Fenton oxidation process. The optimal Fenton oxidation process conditions in the experimental range were pH = 2.0, Fe2+ concentration of 40 mg/L, and H2O2 dosage of 23 mL/L. PDM was treated by biodegradation and subsequent Fenton oxidation under the optimal operating conditions. The removal efficiency was 44.5% after the biodegradation process and further increased to 85.5% after Fenton oxidation. The combined process was revealed to be a promising solution for achieving effective and economical removal of PDM.

Keywords: PDM, Biodegradation, Fenton oxidation, Activated sludge.

Peng Sun[ab], Chunfang Cai[abcde], Youjun Tang[ab], Zhiqiang Tao[f], Wei Zhao[g] (a. Key Laboratory of Exploration Technologies for Oil and Gas Resources (Yangtze University), Ministry of Education, Wuhan 430100, China, b. College of Resource and Environment, Yangtze University, Wuhan 430100, China, c. Key Laboratory of Petroleum Resources Research, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing 100029, China. D. Institution of Earth Sciences, CAS, Beijing 100029, China, e. College of Earth and Planetary Sciences, University of Chinese Academy of Sciences, Beijing 100049, China, f. Exploration & Development Research Institute, Dagang Oilfield Company, PetroChina, Tianjin 300280, China, g. The 2nd Drilling Branch of CNPC Bohai Drilling Engineering Company Limited, Hebei 065007, China). **A new approach to investigate effects of biodegradation on pyrrolic compounds by using a modified Manco scale. Fuel, Volume 265(2020): 116937**

Biodegradation of pyrrolic compounds which are not in the Peters and Moldowan's scale (PM level) has been rarely reported. A suite of oil samples produced from the Neogene Guantao (Ng) Formation in the Bohai Bay Basin was analyzed. They have similar maturity and were derived from similar parent organic matter. The oil samples were assorted into different biodegradation degrees by using modified Manco Number 2 (MN2). Carbazole, methylcarbazole and dimethylcarbazole are found to have been biodegraded, resulting in the decrease in their absolute concentrations with increasing MN2. Alkylcarbazoles are found to be more susceptible to biodegradation than benzocarbazoles, among which, benzo[b]carbazole is the most resistant and 3-methylcarbazole is more resistant than other methylcarbazoles, thus both benzocarbazoles/total carbazoles and 3-methylcarbazole/total methylcarbazoles ratios rise with MN2 values. The bio-resistant sequence of dimethylcarbazole (DMC) is N–H[C1]semi-shielded > exposed > shielded isomers. Compared to the PM level, the Manco scale is more suitable to evaluate the variation patterns of pyrrolic compounds by expressing the level of biodegradation quantitatively with higher resolution than PM level.

Keywords: Carbazole, Benzocarbazole, Biodegradation, Manco scale, Oil

M.Govarthanan[a], Ashraf YZ.Khalifa[bc], S.Kamala-Kannan[e], P.Srinivasan[d], T.Selvankumar[d], K.Selvam[d], Woong Kim[a] (a. Department of Environmental Engineering, Kyungpook National University, Daegu, 41566, Republic of Korea, b. Biological Sciences Department, College of Science, King Faisal University, Saudi Arabia, c. Botany and Microbiology Department, Faculty of Science, University of Beni-Suef, Beni-Suef, Egypt, d. PG& Research Department of Biotechnology, Mahendra Arts and Science College (Autonomous), Kalippatti, Namakkal, 637501, Tamil Nadu, India, e. Division of Biotechnology, College of Environmental and Bioresource Sciences, Chonbuk National University, Iksan, 54596, Republic of Korea). **Significance of allochthonous brackish water**

Halomonas sp. on biodegradation of low and high molecular weight polycyclic aromatic hydrocarbons. Chemosphere, Volume 243(2020): 125389

The present study is aimed to isolate and identify polycyclic aromatic hydrocarbons (PAHs) degrading bacteria from brackish water and to assess the biodegradation efficiency against low and high molecular weight PAHs. Among 15 isolates, the isolate designated as RM effectively degraded 100 mg/L of phenanthrene (Phe) (67.0%), pyrene (Pyr) (63.0%), naphthalene (NaP) (60.0%), and benzo [a]pyrene (BaP) (58.0%) after 7 days of incubation. Carbon sources, pH, and salinity of the culture medium were optimized to enhance the growth and PAHs biodegradation of the isolate RM. Sucrose was found to be an excellent carbon source to enhance PAHs biodegradation (Phe, 75.0; Pyr, 68.5; NaP, 62.5; and BaP, 59.5%). Furthermore, the isolate showed enhanced degradation at pH 7.0 and 4% salinity. The isolate RM was identified as Halomonas sp. based on partial 16S rDNA gene sequence analysis. The results indicated that the isolate RM (i.e., Halomonas sp.) has the potential to be used in remediation of oil spills in the marine ecosystem.

Keywords: Biodegradation, Halomonas sp., Phenanthrene, Phyrene, Salinity

Jinping Tang[a], Xin Rong[a], Decai Jin[b], Chenggang Gu[c], Anwei Chen[a], Si Luo[a] (a. College of Resources and Environment, Hunan Agricultural University, Changsha, 410128, China, b. Environmental Biotechnology, Research center for Eco-Environmental Sciences, Chinese Academy of Sciences, Beijing, 100085, China, c. Key Laboratory of Soil Environment and Pollution Remediation, Institute of Soil Science, Chinese Academy of Sciences, Nanjing, 210008, China). **Biodegradation of phthalate esters in four agricultural soils: Main influencing factors and mechanisms. International Biodeterioration & Biodegradation, Volume 147(2020): 104867**

Phthalate esters (PAEs) are among the frequently detected organic pollutants in agricultural soils. Here, we investigated adsorption and biodegradation behaviors of di-ethyl phthalate (DEP) and dibutyl phthalate (DBP) in the soils collected from four regions in China: Changchun (CC), Changsha (CS), Cangzhou (CZ), and Yinchuan (YC). The results demonstrated that soil organic matter content crucially influenced the adsorption progress. However, the calculated degradation rates of PAEs in the four soils had no significant correlation with their adsorption capacity, suggesting that PAEs' bioavailability might be not the limiting factor governing their degradation. Furthermore, homogeneous biodegradation experiments were performed in the soil solutions extracted from different regional soils. Results showed that biodegradation of PAEs were influenced by the soil solution's pH and its concentration of dissolved organic matter (DOM). To better understand the accelerating mechanism of DOM, bacterial growth and enzyme activity in the presence of Humic acid (HA) and Fulvic acid (FA) were determined, and the degradation of PAEs by intracellular enzymes were also investigated. These results suggested that HA, FA, and other forms of DOM were actively involved in this biodegradation process in two ways: namely, via nutritional support and sequestration of PAEs. We conclude that the actual impact of soil organic matter (SOM) upon PAEs' biodegradation in soils arose from the net outcome of these two opposing effects.

Keywords: Phthalate esters, Adsorption, Biodegradation, Soils, Dissolved organic matter

Alessandro Pischedda, Maurizio Tosin, Francesco Degli-Innocenti (Novamont S.p.A, via Fauser 8, 28100, Novara, Italy). Biodegradation of plastics in soil: The effect of temperature. Polymer Degradation and Stability, Volume 170(2019): 109017

The assessment of the intrinsic biodegradability of plastic materials is made under optimized environmental conditions in order not to limit the microbial growth and activity and follow the biodegradation process until completion. In particular, biodegradation tests are carried out at constant temperature in the range between 20 and 28 °C in order to favour the growth of mesophilic microorganisms. On the other hand, if the purpose is to predict the environmental fate of consumer or professional products made with biodegradable plastics after accidental or deliberate release into the environment, then the biodegradation rate attainable under less optimal conditions should be estimated.

In this work pellets of a commercial biodegradable plastic material were tested for soil biodegradation at 28, 20, and 15 °C. The CO2 evolution was followed for more than one year using the ASTM D 5988–18 test method. The mineralization rates (mg C/day, i.e. the amount of organic carbon converted into CO2 per day) were determined by applying a linear regression from day 140 onwards on the organic carbon depletion curves, when the biodegradation reaction was constant. The specific mineralization rates, i.e. the rate per surface area unit (mg C/day/cm2) were determined by dividing the mineralization rates by the available surface areas of the pellets tested. A thermal performance curve (TPC) was obtained by plotting the specific mineralization rates against the respective temperatures. The TPC curve was perfectly described by an exponential model that was in agreement with the Arrhenius equation. This suggests that biodegradation is dominated by simple thermodynamic effects in the tested temperature ranges (15–28 °C). The apparent activation energy of the biodegradation reaction was 108.7 kJ/mol.

Using the TPC, it was possible to estimate the time needed for total mineralization of a product made with the test material with a given surface area when exposed to different temperatures. Clearly, the effective biodegradation rate was affected by other environmental factors (e.g. nutrients, pH, gas exchange, etc.) besides temperature.

The current work indicates that temperature, an important environmental factor, affects biodegradation rates, in accordance with the Arrhenius equation. The observation that the apparent activation energy of the biodegradation reaction does not vary with temperature in the tested temperature range indicates a persistency in the metabolic activities of the involved mesophilic microbial communities.

Keywords: Biodegradation, Biodegradable, Plastics, Temperature, Environmental fate, Arrhenius.

Carmen Sánchez (Laboratory of Biotechnology, Research Centre for Biological Sciences, Universidad Autónoma de Tlaxcala, Ixtacuixtla, C.P. 90120 Tlaxcala, Mexico). Fungal potential for the degradation of petroleum-based polymers: An overview of macro- and microplastics biodegradation. Biotechnology Advances (2019): 107501

Petroleum-based plastic materials as pollutants raise concerns because of their impact on the global ecosystem and on animal and human health. There is an urgent need to remove plastic waste from the environment to overcome the environmental crisis of plastic pollution. This review describes the natural and unique ability of fungi to invade substrates by using enzymes

that have the capacity to detoxify pollutants and are able to act on nonspecific substrates, the fungal ability to produce hydrophobins for surface coating to attach hyphae to hydrophobic substrates, and hyphal ability to penetrate three dimensional substrates. Fungal studies on macro- and microplastics biodegradation have shown that fungi are able to use these materials as the sole carbon and energy source. Further research is required on novel isolates from plastisphere ecosystems, on the use of molecular techniques to characterize plastic-degrading fungi and enhance enzymatic activity levels, and on the use of omics-based technologies to accelerate plastic waste biodegradation processes. The addition of pro-oxidants species (photosensitizers) and the reduction of biocides and antioxidant stabilizers used in the plastic manufacturing process should also be considered to promote biodegradation. Interdisciplinary research and innovative fungal strategies for plastic waste biodegradation, as well as ecofriendly manufacturing of petroleum-based plastics, may help to reduce the negative impacts of plastic waste pollution in the biosphere.

Keywords: Biodegradation, Fungi, Fungal enzymes, Petroleum-based plastics.

Dan Zhi, Danxing Yang, Yongxin Zheng, Yuan Yang, Yangzhuo He, Lin Luo, Yaoyu Zhou (international Joint Laboratory of Hunan Agricultural Typical Pollution Restoration and Water Resources Safety Utilization, College of Resources and Environment, Hunan Agricultural University, Changsha 410128, PR China), international Joint Laboratory of Hunan Agricultural Typical Pollution Restoration and Water Resources Safety Utilization, College of Resources and Environment, Hunan Agricultural University, Changsha 410128, PR China). **Current progress in the adsorption, transport and biodegradation of antibiotics in soil. Journal of Environmental Management, Volume 251 (2019): 109598**

Antibiotic residues in soil may cause potential risks to human health and soil ecosystems. To avoid these potential risks, comprehensive study of the adsorption, transport and biodegradation of antibiotics in soil is very imperative. This review provided current views about the most recent studies, which have been conducted toward the adsorption, transport and biodegradation of antibiotics in soil. The influencing factors affecting the adsorption behaviors of antibiotics in soil, including the antibiotics properties (e.g., molecular structure, hydrophobicity, polarity, polarizability, and spatial configuration) and the soil characteristics (e.g., soil type, soil pH, coexisting ions, and soil organic matter), were discussed. The effects of fertilizer colloids, porous media, and pH of soil on the transport behaviors of antibiotics were analyzed. The biodegradation of antibiotics in soil were also highlighted by investigating the effects of soil microbiome, soil pH, soil temperature, and interactions between antibiotics. Prospects of antibiotics adsorption, transport and biodegradation were also proposed.

Keywords: Antibiotics, Soil, Adsorption, Transport, Biodegradation

Zhengkun Zhou, Liangsheng Shi, Yuanyuan Zha (State Key Laboratory of Water Resources and Hydropower Engineering Science, Wuhan University, Wuhan, Hubei 430072, China). **Effects of local transverse dispersion on macro-scale coefficients of oxygen-limited biodegradation in a stratified formation. Journal of Contaminant Hydrology, Volume 228(2020): DOI:10.1016/j.jconhyd.2019.103580**

The correct characterization of macro-scale contaminant transport and transformation rates is an important issue for modeling reactive transport in heterogeneous aquifers. While previous studies have investigated field-scale heterogeneity of transport and biochemical properties, the effects of local transverse dispersion on macro-scale transport and transformation rates have not been well understood. In this paper, the process of oxygen-limited biodegradation in a stratified aquifer is analysed by spectral perturbation approach, and longitudinal macrodispersivity, effective biodegradation rate, effective retardation factor and effective velocity are derived for the coupled transport equations of a system consisting of a contaminant and an oxidizing agent (oxygen). The effects of local transverse dispersion on these macro-scale coefficients are studied. It is shown that local transverse dispersion can smooth the heterogeneity in biodegradation and sorption processes and enlarge effective biodegradation rate and retardation factor. The local transverse dispersion can also limit the effects of heterogeneity in biodegradation process on longitudinal macrodispersivities and effective velocities for the contaminant and dissolved oxygen. But the effects of heterogeneity in sorption process on the contaminant macrodispersivity are likely to be magnified by local transverse dispersion.

Keywords: Contaminant transport, Biodegradation, Sorption, Heterogeneity, Effective coefficients, Local transverse dispersion

Biosensor

Amin Fatoni[a], Abdullah Nur Aziz[b], Mekar Dwi Anggraeni[c] (a. Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Jenderal Soedirman, Purwokerto 53123, Indonesia, b. Department of Physics, Faculty of Mathematics and Natural Sciences, Universitas Jenderal Soedirman, Purwokerto 53123, Indonesia, c. Department of Nursing, Faculty of Health Sciences, Universitas Jenderal Soedirman, Purwokerto 53123, Indonesia). **Low-cost and real-time color detector developments for glucose biosensor. Sensing and Bio-Sensing Research (2020): 100325**

One of the analytical methods widely developed is a biosensor, which has several advantages. We reported the development of a real-time colorimetric detector for glucose biosensor using low-cost electrical components of LDR, TCS230 and webcam. The detection was based on the color recognition from the devices resulted in RGB color intensity of the yellow color of hydrogen peroxide and titanium oxysulfate reaction. The comparison of three developed low-cost methods showed that the detector based on TCS230 had the best sensitivity. The real-time colorimetric glucose biosensor using TCS230 showed a good linearity, in the glucose detection of 0.1 to 2.5 mM with the regression equation of $y = 27.89x + 35.31$ ($R2 = 0.993$). Furthermore, the calculated limit of detection of 0.14 mM and calculated limit of quantification of 0.58 mM. The glucose biosensor was also showed high selectivity to detect glucose in the blood sample with good agreement compare to commercial glucose biosensor.

Keywords: Real-time biosensor, Colorimetric biosensor, Low-cost detector, Glucose biosensors.

Xianlong Zhang[a], Di Wu[f], Xuxia Zhou[e], Yanxin Yu[a], Jichao Liu[a], Na Hu[c], Honglun Wang[c], Guoliang Li[ad], Yongning Wu[b] (a. School of Food and Biological Engineering, Shaanxi University of Science and Technology, Xi'an, 710021, China, b. NHC Key Laboratory of Food Safety Risk Assessment, Food Safety Research Unit (2019RU014) of Chinese Academy of Medical Science, China National Center for Food Safety Risk Assessment, Beijing, 100050, China, c. Key Laboratory of Tibetan Medicine Research & Qinghai

Provincial Key Laboratory of Tibetan Medicine Research, Northwest Institute of Plateau Biology, Chinese Academy of Sciences, Xining, 810001, China, d. Key Laboratory of Life-Organic Analysis of Shandong Province, Qufu Normal University, Qufu, 273165, China, e. Department of Food Science and Technology, Zhejiang University of Technology, Hangzhou, 310014, China, f. Yangtze Delta Region Institute of Tsinghua University, Zhejiang, 314006, China). **Recent progress in the construction of nanozyme-based biosensors and their applications to food safety assay. TrAC Trends in Analytical Chemistry, Volume 121(2019): 115668**

Food safety as a huge world public health threat has attracted increasing attention. Effective detection methods are of great importance to ensure food safety. However, the development of reliable and efficient detection methods has been a challenging task because of the complexity of food matrices and trace levels of food contaminants. Recently, emerging nanomaterials with mimetic enzyme activity, namely, nanozymes have been employed for novel biosensor development, which has greatly accelerated the advancement of food safety assay. In this review, we summarize the mechanism and advances in nanozyme-based biosensors such as colorimetric biosensors, fluorescence biosensors, chemiluminescent biosensors, electrochemical biosensors, SERS-based biosensors, and other biosensors. Impressively, the applications of the nanozyme-based biosensors in food safety screening have also been comprehensively summarized (including mycotoxins, antibiotics, pesticides, pathogens, intentional adulteration, metal ions, and others). In the end, future opportunities and challenges in this promising field are tentatively proposed.

Keywords: Colorimetric biosensor, Fluorescence biosensor, chemiluminescent biosensor, electrochemical biosensor, SERS-based biosensor, Food safety assay

Yongli Ye[a], Jian Ji[a], Zhanyi Sun[b], Peili Shen[b], Xiulan Sun[a] (a. State Key Laboratory of Food Science and Technology, School of Food Science, Synergetic Innovation Center of Food Safety and Nutrition, Jiangnan University, Wuxi, Jiangsu 214122, PR China, b. State Key Laboratory of Bioactive Seaweed Substances, Qingdao Brightmoon Seaweed Group Co Ltd, Qingdao, Shandong, 266400, PR China). **Recent advances in electrochemical biosensors for antioxidant analysis in foodstuff. TrAC Trends in Analytical Chemistry, Volume 122(2020): 115718**

Antioxidants play an important role in human health and provide a defense against many diseases. Electrochemical biosensors are considered promising tools for antioxidant research due to their high sensitivity, fast response time, and ease of miniaturization and have penetrated a variety of markets, including food analysis, drug screening, and toxicity research. In this review, recent advances in current state-of-the-art electrochemical biosensors and antioxidant assessment strategies are discussed with a focus on the use of several biosensors, and their advantages and limitations for the rapid and precise analysis of antioxidants in foods. It is concluded that there is widespread applications of electrochaemical biosensors in food quality analysis, the functional evaluation of active factors, and effective components screening. The challenges associated with electrochemical biosensor technology and future directions in this field are also presented.

Keywords: Antioxidant, Electrochemical biosensor, DNA, Enzyme, Cell-based biosensor.

Laís Canniatti Brazaca[a], Isabella Sampaio[a], Valtencir Zucolotto[a], Bruno Campos Janegitz[b] (a. Nanomedicine and Nanotoxicology Group, São Carlos Institute of Physics, University of São Paulo, 13560-970, São Carlos, SP, Brazil, b. Department of Nature Sciences, Mathematics and Education, Federal University of São Carlos, 13600-970, Araras, SP, Brazil). **Applications of biosensors in Alzheimer's disease diagnosis. Talanta, Volume 210(2020): 120644**

Alzheimer's disease (AD) is a neurodegenerative disorder characterized by a progressive and irreversible cognitive decline. Currently, it affects 36 million people and due to population ageing it is estimated that in 2030 disease incidence will reach 60 million individuals. The precise diagnosis of AD is still a complex task, being mainly performed by cerebrospinal fluid (CSF) analysis or neuroimaging techniques such as positron emission tomography (PET) and magnetic resonance imaging (MRI). Despite being effective these techniques are expensive, time-consuming and not accessible for most part of the population. In this scenario biosensors are presented as promising alternatives for simple, rapid and low cost diagnosis of AD. In this revision we summarize the recent advances on biosensors that bring more accessibility to AD diagnosis. We introduce the most used biorecognition elements in miniaturized biosensing systems as well as AD biomarkers present in CSF, in plasma and in genetic material which can be used for disease identification even in early stages. The recent developed biosensors for AD diagnosis using optical, electrochemical and colorimetric techniques as well as their strategies and analytical performances are discussed. Advancements in signal amplification methodologies with nanomaterials to increase biosensors sensitivity are also presented. This review highlights the potential of biosensors to be used as an accurate and portable tool to improve the early AD diagnosis.

Keywords: Alzheimer's disease, Biosensors, Analytical chemistry, Electrochemistry, Optical biosensors.

Namik Akkilic[a], Stefan Geschwindner[a], FredrikHöök[b] (a. Structure, Biophysics and Fragment-based Lead Generation, Discovery Sciences, R&D, AstraZeneca, Gothenburg, Sweden, b. Department of Applied Physics, Division of Biological Physics, Chalmers University of Technology, Gothenburg, Sweden). **Single-molecule biosensors: Recent advances and applications. Biosensors and Bioelectronics, Volume 151(2020): 111944**

Single-molecule biosensors serve the unmet need for real time detection of individual biological molecules in the molecular crowd with high specificity and accuracy; uncovering unique properties of individual molecules which are hidden when measured using ensemble averaging methods. Measuring a signal generated by an individual molecule or its interaction with biological partners is not only crucial for early diagnosis of various diseases such as cancer and to follow medical treatments but also offers a great potential for future point-of-care devices and personalized medicine. This review summarizes and discusses recent advances in nanosensors for both in vitro and in vivo detection of biological molecules offering single-molecule sensitivity. In the first part, we focus on label-free platforms, including electrochemical, plasmonic, and SERS-based and spectroelectrochemical biosensors. We review fluorescent single-molecule biosensors in the second part, highlighting nanoparticle-amplified assays, digital platforms and the utilization of CRISPR technology. We finally discuss recent advances in the emerging nanosensor technology of important biological species as well as future perspectives of these sensors.

Keywords: Single-molecule, Biosensor, Biomarker, Label-free, Electrochemical biosensor, Optical biosensor, Digital assay, Nanoparticle, CRISPR

Sevinc Kurbanoglu, Cem Erkmen, Bengi Uslu (Ankara University, Faculty of Pharmacy, Department of Analytical Chemistry, 06560, Ankara/Turkey). **Frontiers In Electrochemical Enzyme Based Biosensors For Food And Drug Analysis. TrAC Trends in Analytical Chemistry (2020): 115809**

Nowadays, the development of various biosensors as a new generation of analytical instruments is one of the most promising research fields of analytical biology. Among all types of biosensors, enzyme based biosensors have an interesting property, the inherent inhibition phenomena given the enzyme-substrate complex formation. Over the past years, electrochemical enzyme based biosensors have emerged as simple, rapid and ultra-sensitive devices for determination or detection of different compounds in the drugs and food samples. In this review, general views to enzymes related with their history, classification, immobilization, and inhibition information is presented to researchers. Then, a detailed description is provided for enzyme based and electrochemical enzyme based biosensors. Finally, some selected electrochemical enzyme based biosensor studies developed for food and drug analysis are summarized and tabulated.

Keywords: enzyme, biosensors, food analysis, drug analysis, electrochemistry

Danielle L. Schmitt[a], Sohum Mehta[a], Jin Zhang[abc] (a. Department of Pharmacology, University of California San Diego, 9500 Gilman Drive, La Jolla, CA, 92093, USA, b. Department of Bioengineering, University of California San Diego, 9500 Gilman Drive, La Jolla, CA, 92093, USA, c. Department of Chemistry and Biochemistry, University of California San Diego, 9500 Gilman Drive, La Jolla, CA, 92093, USA) **Illuminating the kinome: Visualizing real-time kinase activity in biological systems using genetically encoded fluorescent protein-based biosensors, Current Opinion in Chemical Biology, Volume 54(2020): 63-69**

Genetically encoded fluorescent protein-based kinase biosensors are a central tool for illumination of the kinome. The adaptability and versatility of biosensors have allowed for spatiotemporal observation of real-time kinase activity in living cells and organisms. In this review, we highlight various types of kinase biosensors, along with their burgeoning applications in complex biological systems. Specifically, we focus on kinase activity reporters used in neuronal systems and whole animal settings. Genetically encoded kinase biosensors are key for elucidation of the spatiotemporal regulation of protein kinases, with broader applications beyond the Petri dish.

Keywords: Genetically encoded biosensor, Kinase activity reporters, Kinome

Pedro Carneiro[ab], Simone Morais[b], Maria do Carmo Pereira[a] (a. LEPABE - Laboratory for Process Engineering, Environment, Biotechnology and Energy, Faculty of Engineering, University of Porto, Rua Dr. Roberto Frias, 4200-465, Porto, Portugal, b. REQUIMTE–LAQV, Instituto Superior de Engenharia do Porto, Instituto Politécnico do Porto, R. Dr. António Bernardino de Almeida 431, 4200-072, Porto, Portugal). **Biosensors on the road to**

early diagnostic and surveillance of Alzheimer's disease. Talanta, Volume 211(2020): 120700

Alzheimer's disease is a debilitating and largely untreatable condition with subtle onset and slow progression over an extensive period of time, which culminate in increasing levels of disability. As Alzheimer's disease prevalence is expected to grow exponentially in the upcoming decades, there is an urgency to develop analytical technologies for the sensitive, reliable and cost-effective detection of Alzheimer's disease biomarkers. Biosensors are powerful analytical devices that translate events of biological recognition on physical or chemical transducers into electrical, thermal or optical signals. The high sensitivity and selectivity of biosensors associated with easy, rapid and low-cost determination of analytes have made this discipline one of the most intensively studied in the past decades.

This review centers on recent advances, challenges and trends of Alzheimer's disease biosensing particularly in the effort to combine the unique properties of nanomaterials with biorecognition elements. In the last decade, impressive progresses have been made towards the development of biosensors, mainly electrochemical and optical, for detection of Alzheimer's disease biomarkers in the pico- and femto-molar range. Nonetheless, advances in multiplexed detection, robustness, stability and specificity are still necessary to ensure an accurate and differentiated diagnosis of this disease.

Keywords: Alzheimer's disease, Optical, Electrochemical, Biosensor, Nanomaterials

Bioengineering

M. Patricia D'Souza[a], Shyam Rele[b], Barton F.Haynes[c], Dale J.Hu[a], David L.Kaplan[d], Shadi Mamaghani[e], David Rampulla[f] (a. Division of AIDS, NIAID, Bethesda, MD, USA, b. Division of AIDS (Contractor), NIAID, Bethesda, MD, USA, c. Duke Human Vaccine Institute, Duke University, Durham, NC, USA, d. Department of Biomedical Engineering, Tufts University, Medford, MA, USA, e. Division of Discovery Science and Technology (Contractor), NIBIB, Bethesda, MD, USA, f. Division of Discovery Science and Technology, NIBIB, Bethesda, MD, USA) **Engineering immunity for next generation HIV vaccines: The intersection of bioengineering and immunology, Vaccine, Volume 38,(2020): 187-193**

Bioengineering approaches grounded in immunology have the potential for the discovery and development of a successful HIV vaccine. The overarching goal is to engineer immunity through a fusion of immunology with bioengineering to create novel strategies for the design, development and delivery of vaccines based on the controlled modulation of the immune system. To foster these collaborations, the National Institute of Allergy and Infectious Diseases (NIAID) and National Institute of Biomedical Imaging and Bioengineering (NIBIB) brought together a group of experts (see Table 1) from these diverse fields for a workshop in September 2018 to: (1) engage the engineering, immunology, and HIV vaccinology communities to dialogue on the topic of an HIV vaccine and; (2) generate a framework of new and innovative research avenues to explore in HIV vaccinology between knowledge stakeholders and problem solvers.

Keywords: HIV vaccine, Immunology, Bioengineering, Adjuvants, Neutralizing antibodies

George N.Zaimes[a], Guillermo Tardio[b], Valasia Iakovoglou[c], Martin Gimenez[d], Jose Luis Garcia-Rodriguez[d], PaolaSangalli[ef] (a. UNESCO Chair Con-E-Ect on the Conservation and Ecotourism of Riparian and Deltaic Ecosystems & International Hellenic University, Dept. of Forestry and Natural Environment, Drama 66100, Greece, b. Technical University of Madrid, Spanish Association of Landscape Engineering, Getafe 28905, Spain, c. UNESCO Chair Con-E-Ect on the Conservation and Ecotourism of Riparian and Deltaic Ecosystems, Drama 66100, Greece, d. Technical University of Madrid, School of Forestry, Avda de las Moreras, Madrid 28040, Spain, e. Sangalli Coronel y Asociados SLEFIB (European Federation of Soil and Water Bioengineering), San Sebastian, Gipuzkoa, Spain, f. EFIB (European Federation of Soil and Water Bioengineering), San Sebastian, Gipuzkoa, Spain). **New tools and approaches to promote soil and water bioengineering in the Mediterranean. Science of The Total Environment, Volume 693, (2019): 133677**

Soil loss and erosion is a major environmental problem in the Mediterranean. Soil and water bioengineering uses plants and/or parts of plants along with inert material to create solutions to fulfill soil conservation objectives combined with an ecological rehabilitation approach. The ECOMED project developed novel approaches and tools to specialize the soil and water bioengineering sector within the Mediterranean. The first activity was the Sector Needs Analysis were the responses to an online questionnaire of 110 stakeholders from the region were analyzed. The main conclusion was the need to specialize the soil and water bioengineering sector in the Mediterranean. In addition, 21 soil and water bioengineering case studies in the Mediterranean were reviewed. Many works of this type are implemented in the region, but have flaws because of the lack of training material, design routines, protocols, specific to the region. The second activity developed New Design Routines and Protocols. Specifically, three protocols, one template and one plant database were developed for the region. Finally, in the Training Material activity, six educational modules along with a handbook (that contained modules, protocols, template and case studies) were developed. Overall the ECOMED project generated new and novel material and tools that were lacking in the region to enhance the specialization process of the soil and water bioengineering sector. These should increase the adoption of soil and water bioengineering techniques with better trained and new professionals as well as improve the work performance of these interventions.

Keywords: Conservation practices, Case studies, Stakeholders' views, Soil bioengineering, protocols, Plant database, Training material

Max Hurson[a], Pascale Biron[b] (a. Concordia University, Simon Fraser University, 8888 University Dr, Burnaby, BC V5A 1S6, Canada, b. Concordia University, Canada). **Quantifying hydrodynamic changes associated with bioengineered stabilization measures using numerical modeling. Ecological Engineering, Volume 136,(2019): 118-124**

River bank stabilization is a common practise and can be observed on most rivers around the world, often using hard-engineering riprap. Increasingly, bioengineered approaches using vegetation-based constructive materials is promoted to alleviate some of the negative ecological stresses of bank stabilization. Because these stabilization projects use a variety of techniques to create a site-specific design, they can have unexpected morphological implications and variable ecological benefits which can be anticipated using numerical modelling. Bioengineered bank stabilization creates roughness elements on both micro and macro scales, where only macro-

roughness can be captured by bathymetric adjustments. The definition of micro- and macro-roughness depends on the spatial resolution of the model domain, and may be considered analogous to skin and form friction when characterizing natural alluvial bed environments. The objectives of this research are to assess the hydrodynamic impact of the added micro- and macro-roughness associated with a bioengineering pilot project planned in Quebec, Canada and to use this case study to propose new techniques for integrating increased roughness due to bank stabilization into numerical models. The roughness of the stabilization project is assessed by adjusting bathymetry to simulate macro-roughness features, and roughness coefficients to simulate micro-roughness features. Results show a significant dampening interaction term that reduced the cumulative effect on resistance to flow when both roughness types were applied.

Keywords: River, Bioengineering, Bank stabilization, DELFT3D, Numerical modelling, Roughness

Wanrong Yi[ab], Mei-Juan Tu[b], Zhenzhen Liu[b], Chao Zhang[b], Neelu Batra[b], Ai-Xi Yu[a], Ai-Ming Yu[b] (a. Department of Orthopaedic Trauma and Microsurgery, Zhongnan Hospital of Wuhan University, Wuhan 430072, China, b. Department of Biochemistry & Molecular Medicine, UC Davis School of Medicine, Sacramento 95817, CA, USA). **Bioengineered miR-328-3p modulates GLUT1-mediated glucose uptake and metabolism to exert synergistic antiproliferative effects with chemotherapeutics. Acta Pharmaceutica Sinica B (2019): 159-170**

MicroRNAs (miRNAs or miRs) are small noncoding RNAs derived from genome to control target gene expression. Recently we have developed a novel platform permitting high-yield production of bioengineered miRNA agents (BERA). This study is to produce and utilize novel fully-humanized BERA/miR-328-3p molecule (hBERA/miR-328) to delineate the role of miR-328-3p in controlling nutrient uptake essential for cell metabolism. We first demonstrated successful high-level expression of hBERA/miR-328 in bacteria and purification to high degree of homogeneity (>98%). Biologic miR-328-3p prodrug was selectively processed to miR-328-3p to suppress the growth of highly-proliferative human osteosarcoma (OS) cells. Besides glucose transporter protein type 1, gene symbol solute carrier family 2 member 1 (GLUT1/SLC2A1), we identified and verified large neutral amino acid transporter 1, gene symbol solute carrier family 7 member 5 (LAT1/SLC7A5) as a direct target for miR-328-3p. While reduction of LAT1 protein levels by miR-328-3p did not alter homeostasis of amino acids within OS cells, suppression of GLUT1 led to a significantly lower glucose uptake and decline in intracellular levels of glucose and glycolytic metabolite lactate. Moreover, combination treatment with hBERA/miR-328 and cisplatin or doxorubicin exerted a strong synergism in the inhibition of OS cell proliferation. These findings support the utility of novel bioengineered RNA molecules and establish an important role of miR-328-3p in the control of nutrient transport and homeostasis behind cancer metabolism.

Keywords: Bioengineered RNA, MiR-328, LAT1, GLUT1, Chemosensitivity, Cancer

Lei Lin[ac], Yanlei Yu[c], Fuming Zhang[c], Xing Zhang[bd], Robert J.Linhardt[c] (a. School of Environment, Nanjing Normal University, Wenyuan Road 1, Nanjing, 210023, China, b. School of Food Science and Pharmaceutical Engineering, Nanjing Normal University, Wenyuan Road 1, Nanjing, 210023, China, c. Department of Chemistry and Chemical Biology, Center for Biotechnology and Interdisciplinary Studies, Rensselaer Polytechnic Institute, 110 8th Avenue, Troy, NY, 12180, USA, d. Shandong Provincial Key Laboratory

of Carbohydrate Chemistry and Glycobiology, Shandong University, Jinan, 250100, China). High-throughput method for in process monitoring of 3-O-sulfotransferase catalyzed sulfonation in bioengineered heparin synthesis. Analytical Biochemistry, Volume 586(2019): 113419

Bioengineered heparin (BEH) offers a potential alternative for the preparation of a safer pharmacological heparin. Construction of in-process control assays for tracking each enzymatic step during bioengineered heparin synthesis remains a challenge. Here, we report a high-throughput sensing platform based on enzyme-linked immunosorbent assay (ELISA) and enzymatic signal amplification that allows the rapid and accurate monitoring of the 3-OST sulfonation in BEH synthesis process. The anticoagulant activity of target BEH was measured to reflect the degree of sulfonation by testing its competitive antithrombin (AT) binding ability. BEH samples with different sulfonation degrees show different AT protein binding capacity and thus changes the UV response to a different extent. This BEH-induced signal can be conveniently and sensitively monitored by the plate sensing system, which benefits from its high sensitivity brought in by the enzymatic signal amplification. Furthermore, modification convenience and mechanical robustness also ensure the stability of the test platform. This proposed strategy exhibits excellent analytical performance in both BEH activity analysis and 3-OST sulfonation evaluation. The simple and sensitive plate system shows great potential in developing on-chip, high-throughput methods for fundamental biochemical process research, drug discovery, and clinic diagnostics.

Keywords: Bioengineered heparin, 3-OST sulfonation, Antithrombin binding, ELISA

Philippe Janssen, Paul Cavaillé, Frédéric Bray, André Evette (Univ. Grenoble Alpes, Irstea, LESSEM, 38000 Grenoble, France). Soil bioengineering techniques enhance riparian habitat quality and multi-taxonomic diversity in the foothills of the Alps and Jura Mountains. Ecological Engineering, Volume 133(2019): 1-9

Riparian zones have disproportional ecological importance relative to their size. For decades, the functionality of riparian zones has been altered, with detrimental consequences on biodiversity. Recently, riparian zone restoration has become a major issue. When channel mobility cannot be restored and when erosion control is of primary concern, soil bioengineering techniques are often viewed as a compromise solution. We studied 37 riverbanks, from civil engineering to soil bioengineering, plus natural willow stands, in the foothills of the Alps and Jura Mountains. Using a principal component analysis, we first studied whether terrestrial and aquatic habitat variables varied among riverbank stabilization structures and bank stabilization age and built a synthetic index of riparian habitat quality reflecting the multivariate similarity of riverbank sites. Then, using a modelling approach, we tested whether multi-taxonomic diversity responded to changes in habitat quality and to broad-scale environmental variables (i.e., climate, hydrology and land cover). Soil bioengineering techniques, especially willow fascines and to lower extend vegetated crib wall, enhanced riparian habitat quality by allowing for a greater richness and density of pioneer tree species but also for a larger cover of high quality aquatic micro-habitats. This increase in riparian habitat quality induced an increase in both terrestrial and aquatic species diversity, highlighting the added-value of soil bioengineering techniques to restore riparian biodiversity. This may confirm that stabilization structures made of willow fascines are better suited than stabilization structures made of artificial substrata to support riparian species.

Also, beyond the positive effect of soil bioengineering techniques for riparian biodiversity, we found that climatic, hydrological and land cover variables strongly influenced diversity patterns. Thus, multi-taxonomic diversity decreased along larger rivers and in landscapes dominated by urban areas. This may indicate that the full added value of soil bioengineering techniques for biodiversity will only become apparent if more attention is paid to mitigating the negative impact of human activities in the vicinity of riparian zones and if larger scale environmental parameters are taken into account as early as possible in restoration project. Therefore, we strongly recommend that riverbank restoration projects, based on the active introduction of native pioneer tree species, should be planned at the catchment scale.

Keywords: Biodiversity patterns, Riparian habitat quality, Soil bioengineering techniques, Ecological restoration, Riverbank stabilization

Pollen Biotechnology

Yu-Jin Kim[a], Dabing Zhang[abc], Ki-Hong Jung[a] (a. Graduate School of Biotechnology and Crop Biotech Institute, Kyung Hee University, Yongin 17104, Korea, b. Joint International Research Laboratory of Metabolic and Developmental Sciences, Shanghai Jiao Tong University–University of Adelaide Joint Centre for Agriculture and Health, State Key Laboratory of Hybrid Rice, School of Life Sciences and Biotechnology, Shanghai Jiao Tong University, Shanghai, China, c. School of Agriculture, Food, and Wine, University of Adelaide, South Australia 5064, Australia). **Molecular Basis of Pollen Germination in Cereals. Trends in Plant Science, Volume 24, Issue 12(2019): 1126-1136**

Understanding the molecular basis of pollen germination in cereals holds great potential to improve yield. Pollen, a highly specialized haploid male gametophyte, transports sperm cells through a pollen tube to the female ovule for fertilization, directly determining grain yield in cereal crops. Although insights into the regulation of pollen germination and gamete interaction have advanced rapidly in the model Arabidopsis thaliana (arabidopsis), the molecular mechanisms in monocot cereals remain largely unknown. Recently, pollen-specific genome-wide and mutant analyses in rice and maize have extended our understanding of monocot regulatory components. We highlight conserved and diverse mechanisms underlying pollen hydration, germination, and tube growth in cereals that provide ideas for translating this research from arabidopsis. Recent developments in gene-editing systems may facilitate further functional genetic research.

Keywords: pollen germination, pollen tube, hydration, cereals, rice, maize

Zengxiang Ge[16], Yuling Zhao[16], Ming-Che Liu[2], Liang-Zi Zhou[3], Lele Wang[3], Sheng Zhong[1], Saiying Hou[1], Jiahao Jiang[1], Tianxu Liu[1], Qingpei Huang[1], Junyu Xiao[1], Hongya Gu[14], Hen-Ming Wu[2], JuanDong[5], Thomas Dresselhaus[3], Alice Y.Cheung[2], Li-Jia Qu[147] (1. State Key Laboratory for Protein and Plant Gene Research, Peking-Tsinghua Center for Life Sciences at College of Life Sciences, Peking University, Beijing 100871, China, 2. Department of Biochemistry and Molecular Biology, Molecular and Cell Biology Program, Plant Biology Program, University of Massachusetts, Amherst, MA 01003, USA, 3. Cell Biology and Plant Biochemistry, University of Regensburg, 93053 Regensburg, Germany, 4. The National Plant Gene Research Center (Beijing), Beijing 100101, China, 5. The Waksman Institute of Microbiology, Rutgers the State University of New Jersey, Piscataway, NJ 08854, USA). **LLG2/3 Are Co-receptors in BUPS/ANX-RALF Signaling to**

Regulate Arabidopsis Pollen Tube Integrity. Current Biology, Volume 29, Issue 19(2019): 3256-3265

In angiosperms, two sperm cells are transported and delivered by the pollen tube to the ovule to achieve double fertilization. Extensive communication takes place between the pollen tube and the female tissues until the sperm cell cargo is ultimately released. During this process, a pollen tube surface-located receptor complex composed of ANXUR1/2 (ANX1/2) and Buddha's Paper Seal 1/2 (BUPS1/2) was reported to control the maintenance of pollen tube integrity by perceiving the autocrine peptide ligands rapid alkalinization factor 4 and 19 (RALF4/19). It was further hypothesized that pollen-tube rupture to release sperm is caused by the paracrine RALF34 peptide from the ovule interfering with this signaling pathway. In this study, we identified two Arabidopsis pollen-tube-expressed glycosylphosphatidylinositol-anchored proteins (GPI-APs), LORELEI-like-GPI-anchored protein 2 (LLG2) and LLG3, as co-receptors in the BUPS-ANX receptor complex. llg2 llg3 double mutants exhibit severe fertility defects. Mutant pollen tubes rupture early during the pollination process. Furthermore, LLG2 and LLG3 interact with ectodomains of both BUPSs and ANXURs, and this interaction is remarkably enhanced by the presence of RALF4/19 peptides. We further demonstrate that the N terminus (including a YISY motif) of the RALF4 peptide ligand interacts strongly with BUPS-ANX receptors but weakly with LLGs and is essential for its biological function, and its C-terminal region is sufficient for LLG binding. In conclusion, we propose that LLG2/3 serve as co-receptors during BUPS/ANX-RALF signaling and thereby further establish the importance of GPI-APs as key regulators in plant reproduction processes.

Keywords: pollen tube, glycosylphosphatidylinositol-anchored protein, GPI-AP, RAPID ALKALINIZATION FACTOR, RALF, receptor-like kinase, signaling, Arabidopsis.

I.Kasprzyk[a], A.Ćwik[b], K.Kluska[a], T.Wójcik[b], P.Cariñanos[cd] (a. Department of Environmental Monitoring, Institute of Biology and Biotechnology, College of Natural Sciences, University of Rzeszów, ul. Zelwerowicza 4, 35–601 Rzeszów, Poland, b. Department of Nature Conservation and Landscape Ecology, College of Natural Sciences, University of Rzeszów, ul. Zelwerowicza 4, 35–601 Rzeszów, Poland, c. Department of Botany, Faculty of Pharmacy, Campus de Cartuja, University of Granada, 18071 Granada, Spain, d. IISTA-CEAMA, Andalusian Institute for Earth System Research, University of Granada, Granada, Spain). **Allergenic pollen concentrations in the air of urban parks in relation to their vegetation. Urban Forestry & Urban Greening, Volume 46(2019): 126486**

In the face of the intensifying process of urbanization and the increased incidence of pollen allergies among urban residents, there is still a need to continuously monitor the airborne concentration of allergenic plant pollen. Urban green spaces (UGS) are a desirable element of the urban fabric and necessary for the proper functioning of cities, but they are a rich source of allergenic pollen that may pose a certain risk to people visiting them. The main aim of this study was to analyse the airborne allergenic pollen content in parks of different types relative to a reference point located on the roof of a building. Moreover, this study investigated the relationship between tree canopy volume and the number of recorded airborne pollen grains (SPIn- Seasonal Pollen Integral), and these parameters were compared with the potential impact of vegetation in the parks studied through the Index of Urban Green Zones Allergenicity (IUGZA). Aerobiological monitoring was carried out in Rzeszów, SE Poland in 2016. A

volumetric Hirst-type device was used. The pollen seasons of many taxa largely overlapped at each site where the monitoring was carried out, but the concentration values clearly differed. Tree pollen concentration values were not dependent on total canopy volume, and the greatest disproportions were found for Acer, Betula, Quercus, and Tilia pollen. This may be due to the fact that a solitary tree produces more pollen than a tree growing near others of the same species. The downtown park, surrounded by densely built-up areas, exhibited the highest allergenic potential, and the concentration of pollen, in particular tree pollen, was highest there. It is undesirable to plant hedges of allergenic plants, as they are a rich local source of pollen. Aerobiological monitoring carried out in urban parks provides information about the real threat of allergenic pollen to park visitors.

Keywords: Aerobiology, Allergy hazard, Canopy volume, Pollen, Urban park, Urban ecosystem disservices.

Sevcan Celenk (Bursa Uludag University, Faculty of Arts and Science, Department of Biology, Aerobiology Laboratory, 16059, Nilüfer, Bursa, Turkey). Detection of reactive allergens in long-distance transported pollen grains: Evidence from Ambrosia. Atmospheric Environment, Volume 209(2019): 212-219

The pollen of Ambrosia artemisiifolia (ragweed) is an important aeroallergen. The plant originated from North America and, has spread worldwide in recent decades. Air masses can transport pollen grains far from their source region and episodes of long distance transported (LDT) of ragweed pollen have been reported. The allergenic properties of LDT pollen grains can be altered by humidity, temperature and UV radiation. The aims of the study are to detect the major allergen of ragweed (Amb a 1) in the atmosphere of uninfested areas and to compare daily Ambrosia sp. pollen grains with Amb a 1 amount per m3 of air. Samples for allergen detection were collected by ChemVol® sampler. ChemVol® collects particles at 800 l/min and contains 2 impaction stages ($PM > 10$ μm and $10 > PM > 2.5$ μm). Samples collected on to filters were obtained during a 63 day period in the year 2014. Amb a 1 was recorded on 54 days and pollen grains of ragweed on 43 days. Diurnal average Amb a 1 concentrations ranged between 0.29 and 263.3 pg per cubic meter of air and correlated positively with daily average ragweed pollen concentrations. The average seasonal Ambrosia pollen allergen potency was 2.57 pg Amb a 1/pollen. The air mass movement was simulated using the HYbrid Single-particle Lagrangian Integrated Trajectory (HYSPLIT) model and back-trajectory paths were computed for four episodes. The findings suggest that ragweed pollen allergens still survive after at least 48 h during transport over long distances from allochthonous regions and are therefore a potential trigger of allergic reactions even in areas where ragweed is not widely dispersed.

Keywords: Amb a 1, Ambrosia, Long-distance-transport, Pollen allergen potency, Ragweed pollen.

Raffaella Di Cagno[a], Pasquale Filannino[b], Vincenzo Cantatore[b], Marco Gobbetti[a] (a. Faculty of Sciences and Technology, Libera Università di Bolzano, 39100, Bolzano, Italy, b. Department of Soil, Plant and Food Science, University of Bari Aldo Moro, 70126, Bari, Italy). Novel solid-state fermentation of bee-collected pollen emulating the natural fermentation process of bee bread. Food Microbiology, Volume 82(2019): 218-230

Structure of lactic acid bacteria biota in ivy flowers, fresh bee-collected pollen (BCP), hive-stored bee bread, and honeybee gastrointestinal tract was investigated. Although a large

microbial diversity characterized flowers and fresh BCP, most of lactic acid bacteria species disappeared throughout the bee bread maturation, giving way to Lactobacillus kunkeei and Fructobacillus fructosus to dominate long stored bee bread and honeybee crop. Adaptation of lactic acid bacteria was mainly related to species-specific, and, more in deep, to strain-specific features. Bee bread preservation seemed related to bacteria metabolites, produced especially by some L. kunkeei strains, which likely gave to lactic acid bacteria the capacity to outcompete other microbial groups. A protocol to ferment BCP was successfully set up, which included the mixed inoculum of selected L. kunkeei strains and Hanseniaspora uvarum AN8Y27B, almost emulating the spontaneous fermentation of bee bread. The strict relationship between lactic acid bacteria and yeasts during bee bread maturation was highlighted. The use of the selected starters increased the digestibility and bioavailability of nutrients and bioactive compounds naturally occurring in BCP. Our biotechnological protocol ensured a product microbiologically stable and safe. Conversely, raw BCP was more exposed to the uncontrolled growth of yeasts, moulds, and other bacterial groups.

Keywords: Bee-collected pollen, Fermentation, Bee bread, Lactobacillus kunkeei, Honeybee

Kexin Wen[a], Yixing Chen[a], Xiaojin Zhou[ab], Shu Chang[a], Hao Feng[a], Jing Zhang[a], Zhilin Chu[a], Xiaogang Han[a], Jie Li[a], Jin Liu[a], Chao Xi[a], Heping Zhao[a], Shengcheng Han[a], Yingdian Wang[a] (a. Beijing Key Laboratory of Gene Resources and Molecular Development, College of Life Sciences, Beijing Normal University, Beijing, 100875, China, b. Department of Crop Genomic & Genetic Improvement, Biotechnology Research Institute, Chinese Academy of Agricultural Sciences, Beijing, 100081, China). **OsCPK21 is required for pollen late-stage development in rice. Journal of Plant Physiology, Volume 240(2019): 153000**

In flowering plants, pollen development is a critical step for reproductive success and necessarily involves complex genetic regulatory networks. Calcium-dependent protein kinases (CPKs) are plant-specific calcium sensors involved in the regulation of plant development and adaption to the environment; however, whether they play a role in regulating male reproduction remains elusive. Here, we found that the knockdown of spikelet-specific OsCPK21 causes pollen abortion in OsCPK21-RNAi transgenic plants. Severe defects in pollen development initiated at stage 10 of anther development and simultaneous cell death occurred in the pollen cells of OsCPK21-RNAi plants. Microarray analysis and qRT-PCR revealed that the transcription of OsCPK21 is coordinated with that of MIKC*-type MADS box transcription factors OsMADS62, OsMADS63, and OsMADS68 during rice anther development. We further showed that OsCPK21 indirectly up-regulates the transcription of OsMADS62, OsMADS63, and OsMADS68 through the potential MYB binding site, DRE/CRT element, and/or new ERF binding motif localised in the promoter region of these three MADS genes. These findings suggest that OsCPK21 plays an essential role in pollengenesis, possibly via indirectly regulating the transcription of MIKC*-type MADS box proteins.

Keywords: CPK21MIKC*-type MADS box proteins, indirectly regulation, Pollen development, Rice

Thomas Themelis[a], Roberto Gotti[a], Serena Orlandini[b], Rita Gatti[a] (a. Department of Pharmacy and Biotechnology, University of Bologna, Via Belmeloro 6, 40126, Bologna,

Italy, b. Department of Chemistry "U. Schiff", University of Florence, Via U. Schiff 6, 50019, Sesto Fiorentino, Florence, Italy). Quantitative amino acids profile of monofloral bee pollens by microwave hydrolysis and fluorimetric high performance liquid chromatography. Journal of Pharmaceutical and Biomedical Analysis, Volume 173(2019): 144-153

Bee pollen is an attractive resource in the field of alternative remedies and thanks to the content of carbohydrates, crude fibers, proteins and lipids must be considered as a supplementary food of high potential rate. In characterization of bee pollen with the aim to define its value in human nutrition, the amino acids profile is one of the most important attributes. In the present study, the determination of amino acids composition of different monofloral bee pollen samples was obtained by an approach combining microwave acidic hydrolysis (60 min at 150 °C instead of 22 h at 120 °C in conventional oven) followed by derivatization using 9-fluorenylmethylchloroformate (FMOC-Cl) and separation of amino acids derivatives using a Phenomenex Kinetex core-shell 5 μm C18 (150 x 4.6 mm i.d.) column under a ternary gradient elution. Separation of 19 amino acids was achieved in about 40 min and fluorimetric detection ($\lambda exc = 265$ nm $\lambda em = 315$ nm) allowed selective and sensitive quantitation with LOQ values ranging within 0.14–3.00 μg/mL. Interestingly, the present approach allowed determination of some amino acids e.g., tryptophan and trans-4-hydroxyproline that are often lost by other methods of analysis. Significant differences in the composition of the considered samples were found confirming the impact of botanical origin of the product on its nutritional value. Principal Component Analysis was applied to treat the obtained data, highlighting the importance for discrimination, of detecting low abundance amino acids. The proposed method can be used as an advantageous alternative to the existing ones for characterization of bee pollen as an important source of dietary proteins.

Keywords: Bee pollen, Amino acids, Microwave hydrolysis, Derivatization, Core-shell column, Principal component analysis.

Biotechnology Policy Issue

Samira Khodi Aghmiuni[a], Saeed Siyal[b], Qiang Wang[c], Yuzhen Duan[d] (a. School of Public Affairs, University of Science and Technology of China, Jinzhai Road, Hefei, Anhui, PR China, b. School of Economics and Management, Beijing University of Chemical Technology, Beijing, PR China, c. School of Public Affairs, University of Science and Technology of China, Jinzhai roaad Hefei, Anhui PR China, d. Anhui Open University). Assessment of factors affecting innovation policy in biotechnology. Journal of Innovation & Knowledge (2019): https://doi.org/10.1016/j.jik.2019.10.002

Nearly three decades have passed since the new knowledge and technologies like genetics and biotechnology have emerged. By passing through various periods in which labor force, resources and capital, each one at a certain time, have been comparative and competitive advantages for a more powerful economy, biotechnology is one of the advanced technologies that countries are investing in, in order to achieve sustainable development in the current century. The capabilities of this knowledge are the creation of fundamental and gradual innovations, in addition to the several applications that generate wealth for countries. For this purpose, innovation policies in biotechnology have been addressed here. This study draws on the resource based theory and examines the research development polices, international-corporate collaboration policies and government supportive innovation policies. The statistical population of this study consisted of

165 responses from the directors and experts active in the field of biotechnology industry in Iran (pharmaceutical, food and agriculture). Research hypotheses were tested using SMART PLS software. The results of the research revealed that research development polices, international corporate collaboration policies and government supportive innovation policies have a significant impact on the development of biotechnology innovation activities. In addition, we have discussed the implications of the study as well as given some future directions.

Keywords: Biotechnology, Innovation, Innovation policy, Government support

Haiyan Deng[a], Ruifa Hu[a], Carl Pray[b], Yanhong Jin[b] (a. School of Management and Economics, Beijing Institute of Technology, 5 South Zhongguancun Street, Beijing 100081, China, b. Department of Agricultural, Food and Resource Economics, Rutgers, The State University of New Jersey, 55 Dudley Road, New Brunswick, NJ 08901, United States of America). **Impact of government policies on private R&D investment in agricultural biotechnology: Evidence from chemical and pesticide firms in China. Technological Forecasting and Social Change, Volume 147(2019): 208-215**

China has put in place a series of policies to support private companies to engage in biotechnology research. This study uses data from a survey of 103 major agribusiness firms in the agricultural chemical and seed industries in China to evaluate the impact of government policies on private R&D investment in biotechnology. The results show that firms with positive profit expectation, public R&D subsidies, R&D collaboration with universities/research institutes or state-owned enterprises are more likely to embark on biotechnology research activities. Past patenting activity, R&D subsidies and collaboration with public sector research increase firms' biotechnology R&D investment while firms already selling genetically modified products and firms that are state-owned spend less on R&D. Our findings suggest that government policy does have an important impact on firms' biotechnology R&D investment.

Keywords: Agricultural biotechnology, China, Policies, Private R&D investment

Danielle Ufer, David L.Ortega, Christopher A.Wolf (Michigan State University, Department of Agricultural, Food, and Resource Economics, East Lansing, MI, USA). **Economic foundations for the use of biotechnology to improve farm animal welfare. Trends in Food Science & Technology, Volume 91(2019): 129-138**

Consumer demand for production process traits in food and agricultural products is rapidly increasing. Recent legal measures reflect demand for high animal welfare standards. At the same time, consumers are wary of biotechnology applications in food and agriculture, with calls for natural or organic production across the industry. However, when biotechnologies are applied for the consumer's benefit or address a consumer concern, they become far more acceptable.

This paper explores the economic foundations, challenges and opportunities for consumer acceptance of biotechnology applications in animal welfare, especially gene editing techniques. We review the food economics literature on consumer acceptance of biotechnology to improve animal welfare and discuss the emerging opportunities for future improvements through gene editing using the pork and dairy industries as case studies. We also discuss industry and policy

implications of consumer demand for animal welfare and biotechnology in livestock applications.

Understanding the economic foundations of biotechnology use to improve animal welfare aids agricultural producers, scientists and policy makers to make optimal decisions regarding how these important aspects of animal agriculture progress. We find that the future success of a variety of biotechnologies in livestock production will likely depend on consumer acceptance of the resulting products. Animal welfare applications may increase consumer acceptance.

Keywords: Animal welfare, Consumer attitudes, Food biotechnology, Gene editing, Genetic engineering

Agricultural Biotechnology

Heiko Rischer, Géza R Szilvay, Kirsi-Marja, Oksman-Caldentey (VTT Technical Research Centre of Finland Ltd., FI-02044 VTT, Espoo, Finland). Cellular agriculture — industrial biotechnology for food and materials. Current Opinion in Biotechnology, Volume 61(2020): 128-134

Fundamental changes of agriculture and food production are inevitable. Providing food for an increasing population will be a great challenge that coincides with the pressure to reduce negative environmental impacts of conventional agriculture. Biotechnological manufacturing of acellular products for food and materials has already been piloted but the full profit of cellular agriculture is just beginning to emerge. Cultured meat is a promising technology for animal-based proteins but still needs further development. The concept of plant cells as food offers a very attractive alternative to obtain healthy, protein-rich and nutritionally balanced food raw material. Moreover, cultured microbes can be processed into a wide range of biosynthetic materials. A better control over structural properties will be increasingly important in all cultured cell applications.

Francisco X.Nascimento[ab], Anabel G.Hernández[b], Bernard R.Glick[c], Márcio J.Rossi[b] (a. IBET, Instituto de Biologia Experimental e Tecnológica, Oeiras, 2780-157, Portugal, b. Laboratório de Microbiologia e Bioprocessos, MIP-CCB, Universidade Federal de Santa Catarina, Florianópolis, SC, 88040-900, Brazil, c. Department of Biology, University of Waterloo, Waterloo, ON, N2L 3G1, Canada). Plant growth-promoting activities and genomic analysis of the stress-resistant Bacillus megaterium STB1, a bacterium of agricultural and biotechnological interest. Biotechnology Reports, Volume 25(2020): e00406.

In this work, the stress-resistant Bacillus megaterium STB1 is characterized and its ability to promote plant growth under normal and stress conditions is demonstrated. The genomic sequence of this bacterium, and a detailed analysis of the genes involved in facilitating its stress resistance and plant growth-promoting activities is also reported.

The B. megaterium STB1 genome is rich in genetic elements involved in multiple stress resistance, xenobiotic degradation, pathogen antagonistic activities, and other traits related to soil and rhizosphere colonization. Moreover, genes participating in the biosynthesis of auxins and cytokinins, the modulation of polyamines, GABA, brassinosteroids and ethylene levels were also found.

Ultimately, this study brings new insights into the role of B. megaterium as a plant growth-promoting bacterium and opens new opportunities for the development of novel strategies for agriculture and biotechnology.

Keywords: Bacillus, Megaterium, Plant-growth-promoting bacteria, Genomics, Plant-microbe interactions

Bioenergy

Patrick Withey[a], Craig Johnston[b], Jinggang Guo[b] (a. Department of Economics, St. Francis Xavier University, PO BOX 5000, Antigonish, NS, B2G 2W5, Canada, b. Department of Forest and Wildlife Ecology, University of Wisconsin-Madison, 1630 Linden Drive, Madison, WI, 53705, United States). **Quantifying the global warming potential of carbon dioxide emissions from bioenergy with carbon capture and storage. Renewable and Sustainable Energy Reviews, Volume 115 (2019): 109408**

This study provides estimates of the global warming potential (GWP) of carbon dioxide emissions from bioenergy produced from forests (termed GWPbio). The specific contribution of the study is twofold. First, we consider how GWPbio will be impacted by the inclusion of bioenergy with carbon capture and storage (BECCS) technology. Second, we determine how the assumed baseline or reference scenario impacts GWPbio, considering both bioenergy harvests from currently unmanaged land and harvest residues from currently managed forest lands. BECCS is a major component in the Intergovernmental Panel on Climate Change (IPCC) scenarios that highlight pathways to reduced climate change impacts, and results of this study will inform the viability of using BECCS in forestry to meet IPCC emissions goals. By considering multiple scenarios and using a full carbon-accounting through the inclusion of all carbon pools impacted by harvesting for bioenergy, we demonstrate the conditions under which the value of GWPbio is negative, and thus BECCS acts as a negative emissions technology. Results indicate that assuming a 100-year horizon, GWPbio can vary from between -0.92 and 1.57, depending on a variety of assumptions and whether BECCS is employed. Estimated GWPbio values indicate that bioenergy exceeds the climate impact of fossil fuels if one focuses on unmanaged lands and does not employ BECCS. If one harvests residues from currently managed lands, bioenergy is preferable to fossil fuels without BECCS, but GWPbio is positive. When considering BECCS, bioenergy will have a lower GWP than fossil fuels in all scenarios but will only produce negative emissions if residues are used from currently managed forest lands. The results of this work indicate that bioenergy from forests can only be used to meet IPCC policy goals (produce negative emissions) if BECCS is used on currently managed forest land.

Keywords: Global warming potential, Forestry, Bioenergy, Carbon capture and storage

M.M.M'Arimi[ab], C.A.Mecha[b], A.K.Kiprop[ac], R.Ramkat[a] (a. African Centre of Excellence in Phytochemicals, Textile and Renewable Energy. Moi University, Kenya, b. Department of Chemical and Process Engineering, Moi University, Kenya, c. Department of Chemistry and Biochemistry, Moi University, Kenya). **Recent trends in applications of advanced oxidation processes (AOPs) in bioenergy production: Review. Renewable and Sustainable Energy Reviews, Volume 121(2020): 109669**

Advanced oxidation processes (AOPs) are powerful methods that were traditionally used for treatment of hazardous materials. Based on their resourcefulness, these methods have recently found important applications in various processes of bioenergy production. Despite the growing interest in the application of AOPs in improving the production of bioenergy, there is no comprehensive documentation on how biofuels production operations have increasingly incorporated these oxidation processes. Therefore, the present study aims at reviewing the current state of the art and future prospects of applying AOPs in biofuels production. The usage of these processes in pre-treatment of lignocellulosic biomass, excess sludge, organic effluents, solid wastes and other substrates for energy production was reviewed. It was noted that wet air oxidation has high potential in pretreatment of lignocellulosic biomass for production of various energy types while sonolysis is most effective in biosolids pretreatment. Ozonolysis and photocatalysis are mostly used to selectively remove the colorants in organic effluents. However electrochemical oxidation has good performance in post-treatment of bioenergy effluents. Documented studies indicate that AOPs can be used to enhance trans-esterification thereby boosting biodiesel production. Moreover, they can be used to improve oil extraction from bio-algae to increase biodiesel yields. Comparative studies involving AOPs and conventional processes are necessary to determine their suitability for these applications. The possibility of using AOPs to upgrade low value biofuels to bio-products of higher value should be part of future investigations. A summarized criterion for evaluating the suitability of different AOPs in the production of biofuels is proposed in this study as a guide for their future usage. The main limitation of applying AOPs in bioenergy sector include high process costs due to costly chemicals and energy requirements. Further studies should investigate the possibility of integration of AOPs with conventional methods aimed at improving the process cost-effectiveness.

Keywords: Oxidation, Radical, Biodegradability, Bioenergy, Treatment Process

PritamSingh[a], NadiaSingh[b] (a. Oxford School of Global and Area Studies, University of Oxford, Oxford, UK, b. Northumbria University, Newcastle, UK). **Political economy of bioenergy transitions in developing countries: A case study of Punjab, India. World Development, Volume 124(2019): 104630**

Occupying an important place in the sustainable development discourse, bioenergy was widely touted as the ‘fuel of the future’ at the beginning of the 21st century. However, in recent years, many adverse impacts of commercial bioenergy projects have come to the forefront. These include limited ecological benefits, heightened food insecurity across many developing countries as well as exploitation of local residents by bioenergy producers. There remains a dearth of empirical evidence devoted to investigating bioenergy’s potential as a sustainable energy alternative in developing countries.

It is against this background that our paper is aimed at making two contributions: one, to provide a ground level empirical data on bioenergy initiatives in the Indian Punjab region and, two, to examine the theoretical contribution of eco-socialist perspective to assess the sustainability potentials of bioenergy in developing economies. The eco-socialist perspective treats environmental degradation as a ‘systemic issue’ and considers the power and class structures in capitalism as the central explanatory parameters in explaining the process of environmental degradation. As a part of the transition from capitalism to eco-socialism, the eco-socialists advocate for a participatory approach to environmental decision making to ensure that ecological justice emerges as the central parameter of sustainable development.

The theoretical framing of the case study research on bioenergy projects in the region of Punjab, India was informed by the eco-socialist vision. The case study employed a 'multiple stakeholder' approach to explore the opportunities and contestations surrounding bioenergy projects in Punjab. Identifying key flaws as well as the promises of bioenergy in Punjab that were investigated, our research revealed that in order to be a sustainable energy alternative that meets the objective of ecological and social justice, bioenergy policies need to address the needs of local communities and be cognizant of the inherent socio-economic embeddedness of these initiatives.

Keywords: Bioenergy, Sustainability, Stakeholder approach, Eco-socialism, Environmental justice, Case study

Sandhya Nepal, Liem T.Tran (Department of Geography, University of Tennessee, Knoxville, TN United States). Identifying trade-offs between socio-economic and environmental factors for bioenergy crop production: A case study from northern Kentucky. Renewable Energy, Volume 142(2019): 272-283

Bioenergy crops can provide a reliable and adequate supply of biomass feedstocks to support the bioenergy industry. However, promoting bioenergy crops would require major change in land use and management practices that can have long term socio-economic and environmental impacts. Therefore, it is important to evaluate potential opportunities and challenges presented by bioenergy crop production. We developed a multi-objective optimization model to analyze trade-offs among various components of bioenergy crop production to help make better production decisions. Our model integrated sustainability dimensions including social, economic and environmental factors for bioenergy crop production. As bioenergy crop production may incorporate various objectives, we ran the model by optimizing one objective at a time to measure the magnitude of change in one objective with respect to change in other objectives given a set of constraints. In addition, our model had the ability to assess how trade-offs would be affected by chancing preferences for different factors in the production decisions. The model was applied for a four-county study area in northern Kentucky and it provided a regional examination for the potential of bioenergy crops for energy production. The model can serve as an effective tool for making bioenergy production planning and management decisions.

Keywords: Bioenergy, Trade-offs, Optimization, Sustainability, Decisions, Kentucky

Richard Helliwell[a], Susanne Seymour[a], Paul Wilson[b] (a. School of Geography, University of Nottingham, University Park, Nottingham NG7 2RD, UK, b. School of Biosciences, University of Nottingham, Sutton Bonington Campus, Sutton Bonington, Loughborough LE12 5RD, UK). Neglected intermediaries in bioenergy straw supply chains: Understanding the roles of merchants, contractors and agronomists in England. Energy Research & Social Science, Volume 63 (2020): 101387.

Outside of Denmark, straw-based bioenergy has seen uneven success across Europe. In the UK, straw-based bioenergy has been positioned as making a potentially important contribution to the UK government's energy and environmental objectives. However, growth of the sector has been modest and supply shortages have been experienced despite straw being anticipated as readily available in the UK and surplus to existing market requirements. This paper explores a

previously under theorised and neglected aspect of this story, the role played by agricultural intermediaries, merchants, contractors and advisors. Drawing on interviews with farmers, bioenergy industry representatives, agronomists, straw merchants and contractors from three case study areas, it finds that intermediaries undertake key roles providing physical and social labour required to maintain straw supply chains. They provide baling equipment, maintain informal and formal agreements with producers and users, build and maintain trust, influence on-farm management of straw and increase supply chain resilience to market shocks. However, there is tension between agronomists who advise straw incorporation and the aims of straw merchants/bioenergy policy which seek to incentivise baling. If policy makers are committed to developing a straw-based bioenergy industry, then policy frameworks need to engage in a multi-actor approach that enables the development of committed and well-resourced intermediaries.

Keywords: Cereal straw, Bioenergy policy, Agricultural intermediaries, Farmer decision making, Supply chains, Middle actors.

Mei Qu[a], Ying Lin[bc], Pradipta Halder[d] (a. Center of Natural Resource and Environmental Economics and Management, College of Economics and Management, Northwest A&F University, Yangling, China, b. School of Economics and Finance, Xi'an Jiaotong University, Xi'an, Shaanxi, China, c. School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL, USA, d. Independent Consultant, China). **Analysis of Chinese pupils' intents in using bioenergy through the application of structural equation modeling approach. Journal of Cleaner Production, Volume 231(2019): 386-394**

The present study, based on the structural equation modeling approach and with the help of the Theory of Planned Behavior (TPB), analyzed Chinese pupils' bioenergy related behavioral intentions. Total 453 high school students participated in the study from three Chinese cities. Two structural models were constructed – a standard TPB model with the constructs attitude, subjective norm, perceived behavioral control, and intention, and an extended TPB model with additional constructs of anthropocentric and biocentric beliefs. Result showed that the predictor attitude had positive and the strongest effect on the Chinese students' intents in using bioenergy. The effects of the other TPB predictors and the additional belief constructs were of insignificance. It is concluded that positive attitudes among the Chinese students related to bioenergy could influence their plans to adopt bioenergy in the future. Therefore, the Chinese educators and energy policy makers should consider these findings to improve students' awareness and attitudes concerning bioenergy in China.

Keywords: The theory of planned behavior, Attitude, Bioenergy, China

Danielle Jensen-Ryan[a], Rachael Budowle[b], Sarah Strauss[c], Trevor J.Durbin[d], Tyler A.Beeton[e], Kathleen A.Galvin[f] (a. Department of Institutional Research, Laramie County Community College, Cheyenne, WY 82001, United States, b. Haub School of Environment and Natural Resources, University of Wyoming, Laramie, WY 82071, United States, c. Department of Anthropology, University of Wyoming, Laramie, WY 82071, United States, d. Department of Anthropology, Kansas State University, Manhattan, KS, 66506, United States, e. Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, CO 80523, United States, f. Department of Anthropology, Colorado State University, Fort Collins, CO 80523, United States). **A cultural consensus of fire and futility: Harvesting beetle-kill for wood-based bioenergy in Wyoming and Colorado. Energy Research & Social Science, Volume 58 (2019): https://doi.org/10.1016/j.erss.2019.101272.**

This study investigated key forest stakeholders' perspectives on wood-based bioenergy development in the Medicine Bow Region of Wyoming and Colorado. Utilizing a qualitative data collection and analysis approach, we: (1) documented stakeholders' cultural perspectives to understand opportunities and constraints associated with the use of beetle-killed trees for wood-based bioenergy development in this region and, (2) investigated the potential for wood-based bioenergy development within socio-ecological systems and cultural models frameworks. Our results indicate strong shared cultural beliefs and understandings of wood-based bioenergy development across an array of forest stakeholders. Stakeholders collectively described the potential for this industry and the benefit of utilizing beetle-killed stands in the Medicine Bow. Despite positive perceptions of wood-based bioenergy development, stakeholders predominantly discussed the multitude of ecological and economic constraints outweighing its feasibility. Our findings suggest a cultural consensus across stakeholder groups of the nonviability of a wood-based bioenergy industry and the futility of developing an industry to manage beetle-kill. Overall, stakeholders' considered the impacts of the beetle-kill epidemic to be insurmountable, with fire as the inevitable result of the epidemic.

Keywords: Beetle-kill, Wood-based bioenergy, Rocky Mountains, Socio-ecological systems, Cultural models, Fire.

Nana Baah Appiah-Nkansah[a], Jun Li[a], William Rooney[b], Donghai Wang[a] (a. Department of Biological and Agricultural Engineering, Kansas State University, Manhattan, KS, 66506, United States, b. Department of Soil and Crop Science, Texas A&M University, College Station, TX, 77843, United States). **A review of sweet sorghum as a viable renewable bioenergy crop and its techno-economic analysis. Renewable Energy, Volume 143(2019): 1121-1132.**

Sweet sorghum, a C4 plant, is known to be a unique, versatile, and potential energy crop that can be separated into starchy grains, soluble sugar juice, and lignocellulosic biomass. The fermentable sugars in the juice (53–85% sucrose, 9–33% glucose, and 6–21% fructose) can be directly fermented into ethanol. The grain is primarily starch (62–75%), which can be hydrolyzed and fermented into ethanol. The bagasse, a fibrous lignocellulosic material, can be used to produce cellulosic ethanol, heat and/or power co-generation. In this review, the potential of sweet sorghum for bioenergy production (of various forms) using recently developed cultivars with improved agronomic performance was discussed. In addition, sweet sorghum was compared with other starch, sugar, and lignocellulosic feedstocks. Studies have been conducted on alternative pathways to convert whole sweet sorghum stalks and bagasse into bioenergy. However, very little review of the techno-economic analysis of bioenergy production and co-products from sweet sorghum has been published. The aim of this research was to review the current knowledge of agronomic requirement for cultivating sweet sorghum, the productivity of recently developed cultivars for bioenergy production, and pathways of converting sweet sorghum crop into bioenergy as well as the techno-economic feasibility of using sweet sorghum for bioenergy.

Keywords: Sweet sorghum, Ethanol, Bioenergy, Economic feasibility

Nano Biotechnology

J.N.Sahu[a], H.Zabed[b], Rama Rao Karri[c], Shahriar Shams[d], Xianghui Qi[b] (a. University of Stuttgart, Institute of Chemical Technology, Faculty of Chemistry, Stuttgart, Germany, b. School of Food and Biological Engineering, Jiangsu University, Zhenjiang, China. C. Petroleum and Chemical Engineering, Faculty of Engineering, Universiti Teknologi Brunei, Gadong, Brunei Darussalam, d. Civil Engineering, Faculty of Engineering, Universiti Teknologi Brunei, Gadong, Brunei Darussalam). **Chapter 11 - Applications of nano-biotechnology for sustainable water purification, Industrial Applications of Nanomaterials. Micro and Nano Technologies (2019): 313-340**

In this chapter, nano-biotechnology-based applications, its advantages, and limitations are thoroughly discussed for water and wastewater treatment. The obstacles and constraints of these technologies in the commercialization are also addressed. In the framework of enormous benefits of biotechnology, nano-biotechnology is evolving with the development of antimicrobial nanomaterials, which has potential applications in the removal of pollutants and contaminants as illustrated in this chapter with the relevant reported research studies.

Keywords: Nano-biotechnology, Sustainable water purification, mixed matrix membranes, Zero-valent-iron nanoparticles, Zinc oxide and magnesium oxide nanoparticles

Rama Rao Karria, Shahriar Shamsb, J.N.Sahuc (a. Petroleum and Chemical Engineering, Faculty of Engineering, Universiti Teknologi Brunei, Gadong, Brunei, b. Civil Engineering Programme Area, Faculty of Engineering, Universiti Teknologi Brunei, Gadong, Brunei, c. 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 supplements 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

Biomimicry

Stephanie A.Fernhaber[a], Alyssa Y.Stark[b] (a. Butler University, Lacy School of Business, 4600 Sunset Avenue, Indianapolis, IN, 46208, USA, b. Villanova University, Department of Biology, 800 E. Lancaster Avenue, Villanova, PA, 19085, USA). Biomimicry: New insights for entrepreneurship scholarship. Journal of Business Venturing Insights, Volume 12 (2019): e00137

While the natural world is argued to serve as a powerful source of knowledge and insight, entrepreneurship scholars have struggled to fully engage with nature. This raises the question of whether the antecedents, mechanisms and consequences of entrepreneurship might look differently if nature's time-tested patterns were truly considered. This paper reviews the existing linkages between biology and entrepreneurship. The value of biomimicry in inspiring new insights into entrepreneurial phenomena is then discussed, followed by a biomimicry-based mode of theorizing. Examples and future research directions are provided.

Keywords: Biomimicry, Biology, Entrepreneurship, Theory building

Nihal Amer (Department of Architecture, Faculty of Engineering, October University of Modern Sciences and Arts, MSA, Cairo, Egypt). Biomimetic Approach in Architectural Education: Case study of 'Biomimicry in Architecture' Course. Ain Shams Engineering Journal, Volume 10, Issue 3(2019): 499-506

Environmental aspects are crucial in designing sustainable buildings in relation to context. World is suffering from climate change due to green-house gas emissions. The present work shows the importance of teaching future architects how to implement biomimetic approach as a diverse sustainable way in architectural design. It is intended to clarify potentials of biomimicry as design generators in the course 'Biomimicry in Architecture'ASE433ba-Fall2017 for 4th year architectural students, MSA University, Cairo. This is achieved by analysing the process of teaching biomimicry, staff and students' perception. A questionnaire was distributed among students to evaluate their gained experience of applying biomimicry concept. 18 students attended the course and responded to the questionnaire. Their perception was measured through statistical analysis of questionnaire results. Students enthusiastically applied biomimetic principles in their designs. Incorporating biomimetic approach in architectural design will raise awareness of its importance in professional practice through students' exposure to existing biomimicry projects.

Keywords: Biomimicry, Design projects, Architectural education

Sylvain Kubler[ab], Éric Rondeau[ab], Jean-Philippe Georges[ab], Phoebe Lembi Mutua[ab], Marta Chinnici[c] (a. Universite de Lorraine, CRAN, UMR 7039, Campus Sciences, BP 70239, Vandœuvre-lès-Nancy, F-54506, France, b. CNRS, CRAN, UMR 7039, France, c. ENEA-ICT Division, C.R Casaccia Via Anguillarese 301, ROMA, 00123, Italy). Benefit-cost model

for comparing data center performance from a biomimicry perspective. Journal of Cleaner Production, Volume 231(2019): 817-834

Data centers are estimated to have the fastest growing carbon footprint from across the whole information and communication technology (ICT) sector. Evaluating the performance of data centers in terms of energy efficiency and sustainability is becoming an increasingly important matter for organizations and governments (e.g., for regulation or reputation purposes). It nonetheless remains difficult to achieve such evaluation, as data centers imply to take into consideration a wide range of dimensions and stakeholders. Even though a wide range of sustainability performance indicators exist in the literature, there is still a lack of frameworks to help data center stakeholders (spanning from data center owners, governmental regulators to engineers/field operators) to evaluate and understand how a data center performs in terms of sustainable development/behavior. Our research work proposes such a framework, whose originality lays in the combination of state-of-the-art sustainability metrics with the biomimicry commandments of eco-mature system, which enables holistic sustainability assessment of data centres. From a theoretical perspective, the proposed model is designed based on a benefit-cost analysis using the Analytic Hierarchy Process (AHP) technique. This approach allows data center stakeholders for specifying their own preferences and/or expertise in the comparison process, whose practicability is demonstrated in this paper considering three data center candidates, which are respectively located in France, Germany and Sweden.

Keywords: Green computing, Green networking, Sustainability, Multiple criteria decision-making, Analytic hierarchy process (AHP), Biomimicry

Mojtaba Shamsipur, Afshin Pashabadi (Faculty of Chemistry, Department of Analytical Chemistry, Razi University, Kermanshah, Iran). What has biomimicry so far brought on mysterious natural oxygen evolution? Coordination Chemistry Reviews, Volume 401, (2019): 213068

Complete biomimicking, a quest that has motivated many of scientific communities to attempt to unravel strange aspects of biological water oxidation reaction (WOR). Achieving this utopia allows designing nature-resemble artificial leaves for the final production of oxygen with yields comparable to nature, and ultimately facile production of eco-friendly fuel i.e. molecular hydrogen. The former case, WOR, has been traditionally regarded as the bottleneck which mostly suffers from high energy loss due to the difficulty in decreasing activation energy. Toward this end, tremendous boosts have been assigned to explore the mechanism of a water oxidation reaction in nature and discover the tricks of the trade. The formation of molecular oxygen is catalyzed via an active core in the oxygen-evolving catalyst (OEC) located in photosystem II, where the oxido-manganese bonds arranged in an asymmetrical cluster structure, is responsible for the accumulation of the redox equivalents that are capable for the concurrent abstraction of four electrons/protons from two water molecules. Understanding the precise mechanism of WOR in nature being the subject of frequent of research items, in this way, a reliable approach is constructing artificial architectures that either one mimic different aspects of PSII including the OEC core, the electron transfer chain, and the proton-coupled electron transfer (PCET) aiming to investigate the structural-dependent electronic properties and the redox chemistry of the biomimetic systems, which can discover new details in PSII supercomplex. Here, we discuss a critical overview of the latest advancements in biomimicry that being able to delineate new insights on uncover secrets of WOR in nature.

C.E.Severn[ab], A.M.Eissa[cde], C.R.Langford[f], A.Parker[a], M.Walker[g], J.G.G.Dobbeh, G.J.Streekstra[h], N.R.Cameron[df], A.M.Toyea[b] (a. School of Biochemistry, Biomedical Sciences Building, University of Bristol, Bristol, BS8 1TD, UK, b. National Institute for Health Research Blood and Transplant Research Unit (NIHR BTRU) in Red Blood Cell Products, University of Bristol, UK, c. Department of Polymers, Chemical Industries Research Division, National Research Centre, El Bohouth St. 33, Dokki, Giza, 12622, Cairo, Egypt, d. School of Engineering, University of Warwick, Coventry, CV4 7AL, UK, e. Department of Chemistry, University of Warwick, Coventry, CV4 7AL, UK, f, Department of Materials Science and Engineering, Monash University, Clayton, 3800, Victoria, Australia, g. Department of Physics, University of Warwick, Coventry, CV4 7AL, UK, h. Amsterdam UMC, University of Amsterdam, Department of Biomedical Engineering and Physics, Meibergdreef 9, Amsterdam, the Netherlands). **Ex vivo culture of adult CD34+ stem cells using functional highly porous polymer scaffolds to establish biomimicry of the bone marrow niche. Biomaterials, Volume 225 (2019): 119533**

Haematopoiesis, the process of blood production, occurs from a tiny contingent of haematopoietic stem cells (HSC) in highly specialised three-dimensional niches located within the bone marrow. When haematopoiesis is replicated using in vitro two-dimensional culture, HSCs rapidly differentiate, limiting self-renewal. Emulsion-templated highly porous polyHIPE foam scaffolds were chosen to mimic the honeycomb architecture of human bone. The unmodified polyHIPE material supports haematopoietic stem and progenitor cell (HSPC) culture, with successful culture of erythroid progenitors and neutrophils within the scaffolds. Using erythroid culture methodology, the CD34+ population was maintained for 28 days with continual release of erythroid progenitors. These cells are shown to spontaneously repopulate the scaffolds, and the accumulated egress can be expanded and grown at large scale to reticulocytes. We next show that the polyHIPE scaffolds can be successfully functionalised using activated BM (PEG) 2 (1, 8-bismaleimido-diethyleneglycol) and then a Jagged-1 peptide attached in an attempt to facilitate notch signalling. Although Jagged-1 peptide had no detectable effect, the BM (PEG) 2 alone significantly increased cell egress when compared to controls, without depleting the scaffold population. This work highlights polyHIPE as a novel functionalisable material for mimicking the bone marrow, and also that PEG can influence HSPC behaviour within scaffolds.

Keywords: Three-dimensional, Erythroid, Scaffold, polyHIPE, Haematopoietic, Jagged-1, Functionalisation

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