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On

ENVIRONMENTAL BIOTECHNOLOGY

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on

ENVIRONMENTAL BIOTECHBNOLOGY

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C O N T E N T S

BACKGROUND

Environmental Information System (ENVIS) is established in the year 1984 as a network of Information Centres. It is planned by the Ministry of Environment Forest & Climate Change, Govt. of India. 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. To buildup more awareness to safe the environment as well as for the betterment of livelihood for each and every classess of people in India, now the centre is revump as Environmental Information Awareness, Capacity building and livelihood programme (EIACP) Programme center – Resource Partner

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 43rd publication of Abstract Volume of this EIACP 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 2023. 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 16 heads:

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

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

1. Ingest and degrade organic substances as their food and energy source,

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

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

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

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

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

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

1. Bacterial Biofertilizer
2. Algal Biofertilizer

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

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

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

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

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

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

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

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

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

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

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

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

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

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

ABBREVIATIONS USED IN ADDRESSES AND CITED JOURNALS

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

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

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

Bioaccumulation

Sarang S. Deep, Maheshwar Ramakant Nasnodkar. (Marine Science, School of Earth, Ocean and Atmospheric Sciences, Goa University, Taleigao 403206, Goa, India). Metal speciation in sediments and bioaccumulation in edible bivalves to assess metal toxicity in a sand mining impacted tropical (Aghanashini) estuary, southern India. Marine Pollution Bulletin, Volume 194, Part B (2023): 115455

The study aims to understand the metal toxicity through the relationship between bioavailability in sediments and bioaccumulation in edible bivalves in an estuary subjected to extensive sand mining. The higher deposition of total Fe, Mn, Ni and Zn in the middle region (core M) was ascribed to estuarine processes and proximity to anthropogenic sources. EF revealed moderate to severe enrichment of Ni and Cu in sediments. Igeo showed moderate degree of pollution from Co, moderate to strong pollution from Ni and strong to extreme level of pollution from Cu. In core N, the average bioavailable concentration of Fe, Mn, Zn, Cu, Co and Ni was 1.76 %, 43.18 %, 59.14 %, 62.11 %, 60.42 % and 27.33 % respectively. The average bioavailable concentration of Fe (61.23 %), Mn (56.87 %), Cu (67.98 %), Co (69.77 %) and Ni (40.99 %) was higher in the core M as compared to core N except for Zn (56.98 %). The significant (>25.00 %) proportion of metals in bioavailable fractions in cores N and M construed their non-natural sources. Metal speciation study indicated bioavailability to fauna that likely to enhance by extensive sand mining. The level of Fe, Mn, Zn, Cu and Ni in Saccostrea cucullate, Meretrix casta and Villorita cyprinoides revealed toxicity to bivalves and probably to humans.

Keywords: Bioavailability; Metal accumulation; Ecotoxicology; Anthropogenic activity; Estuary

Albin Jose[a], V. Vineethkumar[b], K.P. Shimod[c], Abhay Ram Balakrishnan[b], M. Jithina[d], Haritha T. Nair[e], Kiran P. Ramakrishnan[f], M. Ramith[g], N.V. Vimal Lakshmanan[g]. (a. Department of Botany, Payyanur College, Edat - 670 327, Kannur, Kerala, India b. Department of Physics, Government College Kasaragod, Vidyanagar-671123, Kasaragod, Kerala, India c. Department of Geography, Government College, Tholanur-678 722, Palakkad, India d. Department of Zoology, Kannur University Campus, Mananthavady-670 645, Wayanad, Kerala, India e. Department of Environmental Science, Bharathiyar University, Coimbatore, Tamil Nadu 641046, India f. Department of PG Studies and research in Geology, Government College Kasaragod, Vidyanagar-671 123, Kasaragod, India g. Wildlife Trust of India, F13, Sector8, Noida, NCR 201301, India). Bioaccumulation and ecological risk assessment of heavy metal contamination in various mangrove species of Kannur District, Kerala, India. Materials Today: Proceedings (2023): https://doi.org/10.1016/j.matpr.2023.06.427

The present investigation measures the concentration of heavy metals in different types of mangroves collected from the banks of the Peruvamba river, Payyanur region, Kannur District. The mangrove species viz. Acanthus illicifolius, Aegiceras corniculatum, Avicennia officinalis, Excoecaria agallocha, and Rhizophora mucronata are selected for the study and the concentrations of heavy metals such as Cd, Hg, Pb, Cu, Mn, Zn, Co, and Fe in the plant samples as well as in the soil samples were measured using Inductive Coupled Plasma-Mass Spectrometer. The concentration of Mn and Zn was relatively high in the soil. The concentration

of Mn was higher in mangroves. The higher value of the transfer factor for Cd, Hg, Pb, and Fe of Aegiceras corniculatum denotes its suitability for heavy metal phytoremediation. The result of this systematic investigation is presented and discussed in this manuscript.

Keywords: Heavy metals; Mangrove; Inductive Coupled Plasma-Mass Spectrometer; Phytoremediation

Jane Gabriella Pereira, Sakshi Shegan Raikar, Abhirajsinh Ghanshyamsinh Bhatti, Pratikshya Ganesh Fatarpekar, Maheshwar Ramakant Nasnodkar. (Marine Science, School of Earth, Ocean and Atmospheric Sciences, Goa University, Taleigao, 403206, Goa, India). Metal bioavailability, bioaccumulation, and toxicity assessment through sediment and edible biota from intertidal regions of the Aghanashini Estuary, India. Marine Environmental Research, Volume 191(2023): 106172

The sediment cores and edible biota from the intertidal regions of the Aghanashini Estuary were studied for the assessment of metal toxicity. The estuarine sediments received natural input of metals through the weathering of Dharwar and peninsular gneisses, and laterites. The sediments were enriched in Fe, Mn, Zn, Cu, Co and Ni than the upper crustal value. Also, the concentration of Fe, Zn, Cu, Co and Ni was more in the Aghanashini Estuary than other estuaries around the world. The Enrichment Factor (EF) revealed enrichment of Zn, Cu, Co and Ni in sediments, while the Geo-accumulation Index (Igeo) exhibited unpolluted-moderately-strongly polluted class of Fe, Zn, Cu, Co and Ni. The enrichment and pollution of metals in sediments was due to anthropogenic sources (domestic sewage, aquaculture and agricultural discharge) in the estuary. The presence of metals at a high concentration in the residual fraction and at a significant proportion in the bioavailable fractions construed both natural and anthropogenic sources of metal, and their bioavailability in the estuary. The physico-chemical factors (ionic composition, H+ ions, redox potential, and microbial activity) regulated the adsorption and desorption of metals in sediments. The Screening Quick Reference Table (SQUIRT) revealed level of bioavailable Mn and Co higher than the Apparent Effects Threshold (AET) and thus, indicated adverse toxic effects on biota. The Risk Assessment Code (RAC) indicated medium-high-very high risk of Mn, Zn, Co, Cu and Ni to biota. Also, the concentration of Fe, Mn, Zn, Cu and Ni in biota was in excess of permissible limit which pointed to their toxicity to biota and their consumers. The Target Hazard Quotient (THQ) value > 1, and Hazard Index (HI) value > 10 revealed risk of metal toxicity to humans.

Keywords: Aghanashini estuary; Geochemistry; Metal pollution; Biota; Human-health

Arunkumar Patchaiyappan[ac], Abimannan Arulkumar[b], Klewos Shynshiang[c], Arumugam Anandkumar[di], Krishnamurthy Prabakaran[e], Asmita Basu[f], Ramakrishnan Sivasankar[g], Suja Devipriya[ch] . (a. Department of Ecology, French Institute of Pondicherry, Pondicherry 605014, India b. Department of Biotechnology, Achariya Arts and Science College (Affiliated to Pondicherry University), Villianur, Puducherry 605 110, India c. Department of Ecology & Environmental Sciences, Pondicherry University, India d. Department of Geography and Environment, Bar-Ilan University, Ramat Gan, Israel e. Department of Marine Science, Faculty of Science, Chulalongkorn University, Bangkok, 10330, Thailand f. CWF Labs: Transdisciplinary Healthcare & Research, Bolpur, West Bengal, India g. Center for Environment and Water, Research Institute, King Fahd University of Petroleum and Minerals, Dhahran 31261, Saudi Arabia h. School of Environmental Studies, Cochin University of Science and Technology, Kochi 682022, Kerala, India i. Department of Oceanography and Coastal Sciences, College of the Coast and Environment, Louisiana State University, Baton Rouge, LA 70808, USA).

Bioaccumulation of heavy metals in commercially important marine species from Puducherry coast, Southeast India. Regional Studies in Marine Science, Volume 65 (2023): 103080

Safety of aquatic products is one of the important public health concerns globally, mainly in developing countries with culture and capture fisheries. In the present study, the bioaccumulation of heavy metals such as Cu, Zn, Cr, Pb, As and Cd in the muscle tissues of crustaceans, molluscs and finfishes collected from the Pondicherry (Puducherry) coast were determined using inductively coupled plasma mass spectrometry (ICP-MS). Among the analysed organisms, maximum concentration of Cu (26.1 ±0.83μg/g) was observed in Perna viridis, Zn (25.03 ±0.82μg/g) in Charybdis feriata, 1.33 ±0.04μg/g of Cr in Atule mate, 1.48 ±1.05μg/g of Pb in Sardinella fimbriata, 2.88±2.16μg/g of Cd in Nemipterus jopanicus and 0.72 ±0.15μg/ g of As in Decapterus russelii. Among the various marine organisms studied, the benthic species showed higher metal accumulation than the pelagic species. The heavy metal accumulation level differed significantly between the organisms. The elemental levels in analysed organisms are within the maximum acceptable levels proposed by various international standards and guidelines. Hazard index (HI) of all the analysed marine organisms showed distinctly lower values than threshold value as suggested by World Health Organization (WHO) and Food Safety and Standards Authority of India (FSSAI) for all the studied elements. Overall, the analysed marine organisms are considered safe for human consumption and export. This study provides the baseline data on heavy metal contamination in edible marine organisms from the Puducherry coast of India that will help in developing effective management plans and continuous monitoring of the coast.

Keywords: Heavy metals, Marine edible organisms, Pondicherry coast, Contamination, Health risk assessment

Nidhi Shrinivas Prabhu Dessai, Vedhangee Santosh Juvekar, Maheshwar Ramakant Nasnodkar. (Marine Science, School of Earth, Oceean and Atmospheric Sciences, Goa University, Taleigao 403206, Goa, India). Assessment of metal bioavailability in sediments and bioaccumulation in edible bivalves, and phyto-remediation potential of mangrove plants in the tropical (Kali) estuary, India. Marine Pollution Bulletin, Volume 194, Part A (2023): 115419

The bioavailability of metals (Fe, Mn, Zn, Cu, Co and Ni) in sediment cores (K-1, K-2, K-3 and K-4) and bioaccumulation in edible bivalves were studied to determine the toxicity of metals in the Kali Estuary, India. Enrichment Factor (EF) construed anthropogenic sources of Zn, Co and Ni, while Geo-accumulation Index (Igeo) revealed pollution of Zn and Ni based on total metal analysis. The Pollution Load Index (PLI >1) supported anthropogenic origin of metals in estuary. Metal speciation study indicated bioavailability of metals in sediments. The bioavailable Mn and Co equalled/exceeded the Apparent Effect Threshold (AET) limit (cores K-1, K-3 and K-4) and indicated toxicity to estuarine biota. The metals in Metetrix casta (Fe, Mn, Zn, Cu, and Ni), Saccostrea cucullata (Fe, Mn, Zn, Cu, Co and Ni) and Villorita cyprinoides (Fe, Mn, Zn, Cu, Co and Ni) exceeded the permissible bioaccumulation limit. Thus, revealed metal toxicity to bivalves and labelled them un-safe for human consumption. Translocation Factor (TF > 1) indicated the use of Kandelia candel in phyto-remediation of Fe, Zn, Cu, Co and Ni at station K-3, and Sonnaretia caseoloris in phyto-remediation of Fe, Zn and Ni at station K-4.

Keywords: Metals, Speciation, Toxicity, Mangroves, Phyto-remediation

Paula Sánchez-Marín[a], Mónica González-Fernández[a], Susana Darriba[b], Juan Santos-Echeandía[a]. (a. Centro Oceanográfico de Vigo, Instituto Español de Oceanografía (IEO-CSIC), Subida a Radio Faro, s/n, 36390 Vigo, Spain, b. Instituto Tecnolóxico para o Control do Medio Mariño de Galicia (INTECMAR), Peirao de Vilaxoán, s/n, 36611 Vilagarcía de Arousa, Spain). **Distribution of metals in the queen scallop Aequipecten opercularis during a transplant experiment: Metal rich granules as drivers of Pb bioaccumulation. Science of The Total Environment, Volume 897 (2023): 165217**

The queen scallop Aequipecten opercularis accumulates high concentrations of lead (Pb) in its tissues, what has led to the interruption of this fishery in some extraction areas in Galicia (NW Spain). This study follows the dynamics of bioaccumulation of Pb and other metals in this species, the tissue distribution and the subcellular partitioning in selected organs, in order to understand the mechanisms that provoke the high Pb levels reached in its tissues and to increase our knowledge about metal bioaccumulation dynamics in this species. Scallops originating from a clean area were exposed in cages in two places in the Ría de Vigo (one shipyard and a less impacted location) and 10 individuals were collected every month over a three months period. Metal bioaccumulation and metal distribution in several organs, including gills, digestive gland, kidneys, muscle, gonad and remaining tissues, was studied. The results showed that scallops accumulated similar levels of Cd, Pb and Zn at both sites, while Cu and Ni showed an opposite pattern at the shipyard, with Cu concentrations increasing around 10 times and Ni decreasing during the 3 months of exposure. The preferential organs for metal accumulation were the kidneys for Pb and Zn, the digestive gland for Cd, both organs for Cu and Ni, and the muscle for As. Subcellular partitioning of kidney samples additionally showed an extraordinary ability to accumulate Pb and Zn at very high concentrations in kidney granules, a fraction that accounted for 30 to 60 % of Pb in soft-tissues. It is concluded that Pb bioaccumulation in kidney granules is the mechanism responsible for the high levels of Pb observed in this species.

Keywords: Bivalve; Subcellular distribution; Detoxification

Nacima Mesli[a], Omar Rouane-Hacene[b], Zoheir Bouchikhi-Tani[a], Jonathan Richir[cd]. (a. University of Tlemcen Abou Bekr Belkaid, Laboratoire Valorisation des actions de l'Homme pour la protection de l'environnement et application en santé publique (VAHPEASP), Department of Biology, BP 119, 13000 Tlemcen, Algeria, b. University of Oran 1 Ahmed Ben Bella, Department of Biology, 31000 Oran, Algeria, c. Station de Recherches Sous-marines et Océanographiques, Punta Revellata, BP33, 20260 Calvi, France, d. SciSca, 5330 Maillen, Belgium). **A first study on the bioaccumulation of trace metals in Rhyssoplax olivacea (Mediterranean Polyplacophora). Marine Pollution Bulletin, Volume 194, Part B (2023): 115202**

This study investigates, for the first time, the bioaccumulation of trace metals in the chiton Rhyssoplax olivacea. Fe, Cu, Co, Cr and Cd were measured in the shell and soft tissue of R. olivacea sampled in five sites along the Algerian west coast during the cold and hot seasons. Physiological and contamination indices were calculated. The condition index provides information on habitat quality and on R. olivacea reproductive performance and physiological status. The metal/shell-weight index informs on the bioavailability of trace metals. The trace element pollution index is used to assign a global contamination status to the studied sites. The trace element spatial variation index ranks Cd and Cr as trace metals of primary environmental concern based on the overall variability of their levels. An exhaustive review compiling data on trace element bioaccumulation in chitons is performed. The potential use of R. olivacea as bioindicator species is discussed.

Keywords: Polyplacophorans; Rhyssoplax olivacea; Mediterranean; Trace metals; Bioaccumulation; Physiological and contamination indices

Zhaowei Wang[a], Hongliang Jia[b], Yan Jiang[a], Song Cui[c], Yi-fan Li[b]. ([a]College of Environmental Science and Engineering, Dalian Maritime University, Dalian, China, [b]International Joint Research Center for Persistent Toxic Substances (IJRC-PTS), College of Environmental Science and Engineering, Dalian Maritime University, Dalian, China, [c]IJRC-PTS, School of Water Conservancy and Civil Engineering, Northeast Agricultural University, Harbin, China). **Bioaccumulation of novel brominated flame retardants in crucian carp (*Carassius auratus*): Implications for electronic waste recycling area monitoring. Environmental Research, Volume 239, Part 2 (2023): 117412**

Bioaccumulation factor (BAF) of pollutants is an important parameter for evaluating their bioaccumulation potential and an important indicator for evaluating their environmental risks. However, little study exits on the BAF of novel brominated flame retardants (NBFRs). The present study determined 17 NBFRs in 24 water samples in dissolved phase and 93 crucian carp samples collected from an electronic waste recycling site in northern China, in order to examine their contamination, distribution and bioaccumulation. The results showed that the targeted NBFRs were widely detectable in the dissolved phase and crucian carps. In dissolved phase, allyl 2,4,6-tribromophenyl ether (ATE) had the highest detectable rate (100%) and concentration (mean: 1.3 ± 0.62 ng/L), but in crucian carp, hexachlorocyclopentenyl-dibromocyclooctane (HCDBCO) was the one with the highest detectable rate (89%) and concentration (mean: 16 ± 9.2 ng/g wet weight (ww)) among all 17 NBFRs. The discharge and water solubility of NBFRs determined their concentration in the dissolved phase, while the concentration of NBFRs in crucian carp was the results of their discharge and food exposure. The estimated BAFs exceeded 5000 L/kg for petabromoethylbenzene (PBEB), pentabromotoluene (PBT), HCDBCO, pentabromobenzyl acrylate (PBBA), 1,2,3,4,5-pentabromobenzene (PBBZ), 2,3-dibromopropyl-2,4,6-tribromophenyl ether (DPTE), hexabromobenzene (HBBZ), and α-1,2,5,6-tetrabromocyclooctane (α-TBCO), suggesting that these compounds were above the hazard standard of bioaccumulation. Although the BAFs of 2,3,5,6-tetrabromo-p-xylene (p-TBX), 1,2-bis(2,4,6-tribromophenoxy)-ethane (BTBPE), α-/β-tetrabromoethylcyclohexane (α-/β-TBECH) and ATE were less than 5000, the potential of bioaccumulation cannot be ignored. The log BAF of tested NBFRs showed a pattern of first increasing and then decreasing with the increase of log K_{OW}, the water solubility of NBFRs, the exposure to fish, the uptake and depuration of fish were the key factor to this pattern. To our knowledge, the BAF values of the most of NBFRs calculated in this study were not reported in the published work previously.

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Department of Biology, Animal and Environment, Has Green Academy, Po Box 90108, 5200 MA's-Hertogenbosch, the Netherlands, [f]Masaryk University, Faculty of Science, Department of Botany and Zoology, Kotlářská 2, 61137 Brno, Czechia, [g]Charles University, Faculty of Science, Institute of Environmental Studies, Benátská 2, 12801 Prague, Czechia, [h]Charles University, Faculty of Science, Department of Zoology, Viničná 7, 12844 Prague, Czechia). **Bioaccumulation of chemical elements at post-industrial freshwater sites varies predictably between habitats, elements and taxa: A power law approach. Science of The Total Environment, Volume 901(2023): 165794**

Elevated environmental levels of elements originating from anthropogenic activities threaten natural communities and public health, as these elements can persist and bioaccumulate in the environment. However, their environmental risks and bioaccumulation patterns are often habitat-, species- and element-specific. We studied the bioaccumulation patterns of 11 elements in seven freshwater taxa in post-mining habitats in the Czech Republic, ranging from less polluted mining ponds to highly polluted fly ash lagoons. We found nonlinear, power-law relationships between the environmental and tissue concentrations of the elements, which may explain differences in bioaccumulation factors (BAF) reported in the literature. Tissue concentrations were driven by the environmental concentrations in non-essential elements (Al, As, Co, Cr, Ni, Pb and V), but this dependence was limited in essential elements (Cu, Mn, Se and Zn). Tissue concentrations of most elements were also more closely related to substrate than to water concentrations. Bioaccumulation was habitat specific in eight elements: stronger in mining ponds for Al and Pb, and stronger in fly ash lagoons for As, Cu, Mn, Pb, Se, V and Zn, although the differences were often minor. Bioaccumulation of some elements further increased in mineral-rich localities. Proximity to substrate, rather than trophic level, drove increased bioaccumulation levels across taxa. This highlights the importance of substrate as a pollutant reservoir in standing freshwaters and suggests that benthic taxa, such as molluscs (e.g., *Physella*) and other macroinvertebrates (e.g., *Nepa*), constitute good bioindicators. Despite the higher environmental risks in fly ash lagoons than in mining ponds, the observed ability of freshwater biota to sustain pollution supports the conservation potential of post-industrial sites. The power law approach used here to quantify and disentangle the effects of various bioaccumulation drivers may be helpful in additional contexts, increasing our ability to predict the effects of other contaminants and environmental hazards on biota.

Keywords: Trace elements; Heavy metals; Macroinvertebrates; Fish; Microhabitat; Trophic level; Coal combustion residues

Bioremediation

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Engineering, SIMATS, Chennai, 602105, India). Microalgae-enhanced bioremediation of Cr(VI) ions using spent coffee ground-derived magnetic biochar MoS_2–Ag composites. Journal of Environmental Management, Volume 348 (2023): 119259

Composites of magnetic biochar derived from spent coffee grounds were prepared using MoS_2 decorated by plasmonic silver nanoparticles (MoS_2–Ag), which were used for the bioremediation Cr^{6+} ions. The composites were characterized by electron microscopy, X-ray diffraction, Raman, and UV-VIS spectroscopy. The bioremediation of Cr^{6+} ions was enhanced almost two times compared to microalgae, *Spirulina maxima*. Such an increased activity is attributed to heterojunction formation of Biochar@MoS_2–Ag composite due to the synergetic effects of surface plasmon resonance of AgNPs inducing amplified local electric field, thus simultaneously increasing the absorption of MoS_2 under visible or near-infrared light. The combination of Biochar@MoS_2–Ag and *Spirulina maxima* powder was effective for the separation (microalga-based absorption and accumulation of Cr^{6+} ions) of photo-induced carriers (composite-assisted to breakdown Cr^{6+} ions). This study offers efficient eco-friendly treatment of Cr^{6+} ions by reporting the first enhanced bioremediation of Cr(VI) ions by microalgae using MoS_2–Ag-modified biochar obtained from consumed coffee grounds.

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The presence of arsenic in water poses a serious threat to both human health and natural systems, and is a global chronic issue. A comprehensive study on the water sample of Taptapani Hot Spring Odisha, India was carried out to isolate Arsenic (III) bioremediating microbial strains. 42 different bacterial isolates were screened and among them, phylogenetic analysis revealed the strains showing improved metal tolerance test adaptivity at various concentrations of Arsenic (III) to be closely related to Exiguobacterium sp. (SSB11), Alcaligenes faecalis DZ2 (SSB17) and Lysinibacillus sphaericus SI-3 (SSB58) and hence selected. The findings revealed that the consortium of thermophilic isolates was more effective at adsorbing Arsenic (III) than single isolates. The analysis of variance (ANOVA) revealed a significant coefficient of determination value and accurately forecast second order regression. The isotherm model had been applied for the first time to evaluate the arsenic adsorption efficacy of hot spring bacterial isolates, and the data were en suite to pseudo-first and second-order models. The kinetic data were fitted to Langmuir and Freundlich models. The most favorable elimination circumstances have been resolute and under optimal conditions, the adsorption of Arsenic (III) was found to be 50.28%.

Keywords: Arsenic (III); Bioremediation; Hotspring; Isotherm; Optimization

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China, b. Hubei Three Gorges Laboratory, Yichang, 443007, China). Mechanisms of combined bioremediation by phosphate-solubilizing fungus and plants and its effects on cadmium contamination in phosphate-mining wastelands. Journal of Environmental Management, Volume 346 (2023): 118983

Owing to uncontrolled mining activities and lack of ecological protection measures, phosphate-mining wastelands are contaminated with the heavy metal Cd. In this study, Penicillium oxalicum strain ZP6, a Cd-resistant phosphate-solubilizing fungus, was used in combination with the fast-growing, high-biomass plant Brassica juncea L. to enhance Cd remediation in phosphate-mining wastelands. Further, the bioremediation mechanisms were explored and elucidated. In pot experiments, strain ZP6 and Brassica juncea L. alone were significantly effective in removing Cd from phosphate-mining wastelands; however, their combination was more effective, exhibiting a high removal rate of 88.75%. The presence of phosphorite powder increases soil-enzyme activity, promotes plant growth, and reduces the bioaccumulation and translocation factors. However, Cd-inhibited plant growth and chlorophyll content increased malondialdehyde accumulation, which was alleviated by inoculation with strain ZP6. The results from the study indicate that bioremediation using a combination of strain ZP6 and plants is a restoration strategy with appreciable potential to resolve Cd contamination in phosphate-mining wastelands.

Keywords: Cadmium contamination; Penicillium oxalicum; Phytoremediation; Rhizosphere; Soil enzymes

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The incorrect disposal of textile dyes, such as Reactive Black 5 (RB5), causes several problems for living beings and the quality of the environment. Nanobiocomposites (NBC) produced from endophytic fungi (potentially remediation dyes-agents) and magnetic nanoparticles have high biotechnological potential due to their superparamagnetic behavior, which would allow their recovery through the magnetic field after the bioremediation process. This work aimed to obtain a new nanobiocomposite from the interaction of magnetite nanoparticles (Fe3O4) with the endophyte Aspergillus flavus (Af-CL-7) to evaluate its bioremediation capacity and to reduce the toxicity of RB5 and its reuse. Before obtaining the NBC, Af-CL-7 showed discoloration of RB5 and it was tolerant to all tested concentrations of this dye. The discovery of the nanobiocomposite textile dye bioremediator product presents a significant environmental

advantage by addressing the issue of water pollution caused by textile dyes. The NBC called Af-Fe3O4 was successfully obtained with the magnetized endophyte, and their magnetic properties were verified by VSM analysis and by action of magnetic fields generated by Nd-Fe-B magnets SEM analyzes showed that the nanoparticles did not cause any damage to the hypha morphology, and TEM analyzes confirmed the presence of nanoparticles in the fungus wall and also inside the cell. The NBC Af-Fe3O4 and Af-CL-7 showed, respectively, 96.1% and 92.2% of RB5 discoloration in the first use, 91.1% e 86.2% of discoloration in the validation test, and 89.0% in NBC reuse. In the toxicological bioassay with Lactuca sativa seeds, NBC showed a positive reduction in the toxicity of RB5 after treatment, allowing the hypocotyl growth to be statistically similar to the control with water. Thus, we highlight the promising obtaining process of NBC that could be applied in bioremediation of contaminated waters, wherein the industrial economic cost will depend on the fermentation efficiency, biomass production and nanoparticle synthesis.

Keywords: Magnetite nanoparticles; Endophytic microorganisms; Reduction of toxicity; Remediation; Wastewater treatment

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The landfill leachate and industrial effluents (farm of swine, poultry, cattle, distilleries, etc.) present concentrations above 800 mg.L−1 of ammoniacal nitrogen. The absence of economically viable processes for its removal has led to the loss of the water body potability. An innovative bioprocess was developed for the bioremediation of NH3. The residual crude glycerol from biodiesel production was innovatively used in a mixed culture of heterotrophic bacteria and cyanobacteria to reduce the NH3 toxicity and enhance the consumption of the NH3. >600 mg.L−1 of NH3 (consumption of 100 mg.L−1.d−1) was consumed in just 8 days, with efficiency of 100 % approximately. Also, there was a promising production of compounds of industrial interest by these microorganisms: polyhydroxyalkanoates (PHAs) for biodegradable plastics by heterotrophic bacteria (132 ± 19 mg.g−1); pigments by A. platensis (phycocyanin: 84.2 ± 2.8 mg.g−1 and total carotenoid: 1.62 ± 0.18) and proteins (38 ± 2 %)., with a maximum biomass productivity of 0.435 ± 0.004 mg.L−1.d−1.

Keywords: Ammoniacal nitrogen; Crude glycerol; Polyhydroxyalkanoates; A. platensis

Manpreet Kaur[a], Arun Karnwal[b] (a. Department of Biotechnology, School of Bioengineering and Biosciences, Lovely Professional University, Punjab, India, b. Department of Microbiology, School of Bioengineering and Biosciences, Lovely Professional University, Punjab, India). **Screening of endophytic Bacteria from stress-**

tolerating plants for abiotic stress tolerance and plant growth-promoting properties: Identification of potential strains for bioremediation and crop enhancement. Journal of Agriculture and Food Research, Volume 14 (2023): 100723

Enhancing plant productivity and fortifying defense mechanisms against biotic and abiotic stresses is crucial for sustainable agriculture. To achieve this, researchers have investigated the use of endophytic bacteria as a viable alternative to chemical fertilizers and pesticides. In this study, 50 endophytic microbes were isolated from stress-tolerant parts of different plants, including Lantana camara, Phoenix dactylifera, Hemerocallis fulva, Salvia rosmarinus, Commiphora wightii, and Abutilon indicum. These microbes were evaluated for their tolerance to abiotic stresses and ability to promote plant growth. Among the isolates, R1L2 and A2L2L2 exhibited the highest tolerance to salt stress, withstanding up to 16% NaCl. DL2R2, R1L2, and A1S1S were the most tolerant to lead stress, tolerating up to 6% w/v lead. For cadmium stress, R1L2, DL3R2, and DP1L1L1 showed the highest tolerance, enduring up to 6% w/v cadmium. The isolates were also assessed for their plant growth-promoting (PGP) activities, including the production of IAA, Gibberellin, Cytokinin, HCN, siderophore, phosphate solubilization, and nitrogen fixation. All isolates were positive for nitrogen fixation attribute. However, under specific stress conditions, all isolates showed negative results for HCN production, siderophore production, or inorganic phosphate solubilization. Isolates A1S1S and DL3R2 demonstrated positive results for producing phytohormones such as IAA, Gibberellin, and Cytokinin. Through phenotypic and biochemical characteristics, as well as 16S rDNA gene sequencing, isolate A1S1S was identified as Pelomonas aquatic (accession no. OP984335), and isolate DL3R2 was identified as Solibacillus silvestris (accession no. OP854919). These findings suggest that the endophytic strains Pelomonas aquatic and Solibacillus silvestris have potential applications as multi-stress reducers, bioremediation agents, and crop growth promoters in essential crops.

Keywords: Abiotic stress; Salinity; Cadmium; Lead; Plant growth promotion; IAA

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industry's effluent targeting bioremediation. Results in Chemistry, Volume 6 (2023): 101038

In this study, bacterial strains from the Bacillus genus were isolated from residual effluents from treatment unit of a Petroleum Factory to produce a biosurfactant, aiming the bioremediation of oil-contaminated soils. Five strains were selected to perform fermentation tests. Results showed that the strain LUB P1 presented a lipopeptide with excellent properties, which reduced the surface tension to rates below 30 mN/m. The bacteria were genetically identified as a species belonging to the Bacillus subtilis. Characterization of the biosurfactant confirmed that the main component is surfactin, with a critical micellar concentration (CMC) value of 15 mg.L−1 and high stability to temperature, salinity, and pH variations. In addition, showed low toxicity compared to synthetic surfactants. Bioremediation tests indicated motor oil removal efficiency of over 80% on the temperature of 60 °C in its CMC, presenting excellent properties for the application in bioremediation.

Keywords: Isolation; Biosurfactant; Bioremediation; Surface tension

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Due to rising populations and human activities, heavy metals (HM) toxicity has become a serious problem for all life forms. The present study deals with isolating and identifying lead-resistant bacteria from contaminated wastewater of tanneries effluents. Two isolated strains were identified as Bacillus cereus (ID1), and Bacillus sp. (ID3), and both strains resisted a 25 mM concentration of Lead nitrate (Pb (NO3)2). After four days of treatment, Bacillus cereus (ID1) showed 80% lead uptake, and Bacillus sp. (ID3) showed 88%. Lead uptake was confirmed by Energy dispersive X-Ray (EDX) analysis. Fourier transform infrared spectroscopy (FTIR) showed that structural alterations had occurred in functional groups of the treated samples compared to the controls. Our research indicates that these Bacillus strains may be useful in bioremediating heavy metals from polluted environments. Further investigation into the processes involved in the uptake and homeostasis of heavy metals by these strains is required, as is the identification of the genes and enzymes responsible for Pb-bioremediation.

Keywords: Heavy metals pollution; Pb-contamination; Bacillus cereus ID1; Bacillus sp. ID3; Bioremediation

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Ningbo 315211, China, [e]Global Centre for Environmental Remediation, Faculty of Science, University of Newcastle, Callaghan, NSW 2308, Australia). Dose–effect of nitrogen regulation on the bioremediation of diesel contaminated soil. Environmental Technology & Innovation, Volume 32 (2023): 103245

Nitrogen regulation is an effective method to enhance the bioremediation of hydrocarbon contamination. In this study, various dosages of two types of nitrogen sources were spiked to the diesel contaminated soil in a 60-day microcosmic experiment. The results showed that the total petroleum hydrocarbon (TPH) degradation rate improved from control test of 32.03% to the highest of 44.74% with nitrogen spiking. Peptone and KNO_3 significantly improved the bioremediation of diesel-contaminated soil, peptone was more effective than KNO_3 at low dosage. The soil C:N ratio of 20:1 (T1 treatment with the addition of peptone) was the optimal treatment. The effect of two nitrogen on soil pH was reverse, high dose of peptone addition significantly increased soil pH, but KNO_3 addition significantly decreased soil pH. The soil bacteria diversity decreased significantly in the high dose Peptone treated soil, while the changes of bacteria diversity of KNO_3 treated soil was just opposite. Furthermore, nitrogen regulation significantly changed the structure of soil bacterial community, *Rubrobacter*, *Solirubrobacter* and *Gaiella*, which belonging to *Actinomycetota*, were identified as the three common genus with hydrocarbon degrading ability in different nitrogen amended soil. Peptone and KNO_3 had different mechanisms on the bioremediation of diesel contaminated soil. The properties of these two nitrogen sources provides us with more options for the bioremediation of hydrocarbon contaminated acid or alkaline soil.

Keywords: Diesel contaminated soil; Total petroleum hydrocarbon; 16S rRNA; Bacterial community

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The increasing anthropogenic and technogenic activities to compensate the raising population and unending demands of humans ended in severe pollution and detrimental damage to the environment. This environmental pollution due to lethal pollutants, toxic heavy metals and organic wastes has been drastically affecting the ecosystem of the living organisms. These are forced to enter into the food chain as they tend to accumulate in the agricultural soils. In order to eliminate these pollutants from the soils the bioremediation will be an efficient tool and this can be achieved by plant growth promoting rhizobacteria and by green wastes. In this study the plant growth promoting rhizobacteria (PGPR) and green wastes are evaluated for their effectiveness in bioremediating the toxic contaminants. Green wastes are rich sources of naturally occurring polyphenols which are potential eliminating agents of these pollutants, they can perform metal chelation, reduction, antibiotic properties, adsorption, complexation and by supplying the nutrients. However, PGPRs are well known plant life saviors from various biotic and abiotic stresses; they are also the bioremediating agents as they perform heavy metal elimination by various methods. In this study, it is also depicted that the combined application of PGPR and

green wastes result in the significant method to bioremediate the contaminated sites. The bioremediation by PGPRs and green wastes is the prominent effective way to terminate the pollutants compared to phytoremediation.

Keywords: Bioremediation; Bioresources; Green waste; Heavy metals; PGPR

Biotransformation

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Nitrate and SMX both play a critical role in their biotransformation in biodegradable polymer-supported denitrification biofilters. However, the mutual influences of nitrate and SMX on their biotransformation for long-term operation remained obscure. Results showed SMX and nitrate had divergent effects on SMX removal. SMX removal rates was positively related with its loading rates, whereas they were negatively related to NLRs. The most abundant metabolite C10H14O3N3S (the reduced form of SMX moiety) from the N–O bond cleavage pathway by UHPLC-LTQ-Orbitrap-MS/MS and effluent TOC variations confirmed the presence of electron donor competition between nitrate and SMX. SMX less than 1000 μg/L had a negligible influence on denitrification performance. Denitrifiers such as Azospira and Denitratisoma were still enriched after chronic exposure, and nosZ/narG positively correlated with sul1/sul2 resistance genes, which were both responsible for the negligible influence of SMX. This work could guide the operational management of denitrification biofilters for simultaneous nitrate and antibiotics removal.

Keywords: Denitrification; SMX biotransformation; Microbial community structure; Resistant gene; Denitrification gene

Jiawen Yang[a], Aixuan Zhou[a], Minyi Li[a], Qiaoxian He[a], Jingwei Zhou[a], Jacques Crommen[ab], Wentao Wang[c], Zhengjin Jiang[ab], Qiqin Wang[ab] (a. Institute of Pharmaceutical Analysis, College of Pharmacy/State Key Laboratory of Bioactive Molecules and Druggability Assessment/International Cooperative Laboratory of Traditional Chinese Medicine Modernization and Innovative Drug Development of Ministry of Education (MOE) of China, Jinan University, Guangzhou 510632, China, b. Laboratory for the Analysis of Medicines, Department of Pharmaceutical Sciences, CIRM, University of Liege, Liege B-4000, Belgium, c. SCIEX, Shanghai 200050, China). Mimotope peptide modified pompon mum-like magnetic microparticles for precise recognition, capture and biotransformation analysis of rituximab in biological fluids. Acta Pharmaceutica Sinica B (2023): 2023.10.018

Due to low immobilized ligand density, limited binding capacity, and severe interference from serum proteins, developing ideal peptide-based biomaterials for precise recognition and in vivo analysis of biopharmaceuticals remains a huge challenge. In this study, mimotope peptide modified pompon mum-like biomimetic magnetic microparticles (MMPs, 3.8 μm) that mimic the specific functionalities of CD20 on malignant B cells were developed for the first time. Benefit from the numerous ligand binding sites (Ni2+) on the pompon mum-like MMPs, these novel materials achieved ≥10 times higher peptide ligand densities (>2300 mg/g) and antibody binding capacities (1380 mg/g) compared to previous reported biomaterials. Leveraging the high specificity of the mimotope peptide, rituximab can be precisely recognized and enriched from cell culture media or serum samples. We also established an LC–MS/MS method using the MMPs for tracking rituximab biotransformation in patient serum. Intriguingly, deamidation of Asn55 and Asn33, as well as oxidation of Met81 and Met34 were observed at the key complementarity determining regions of rituximab, which could potentially influence antibody function and require careful monitoring. Overall, these versatile biomimetic MMPs demonstrate superior recognition and enrichment capabilities for target antibodies, offering interesting possibilities for biotransformation analysis of biopharmaceuticals in patient serum.

Keywords: Therapeutic monoclonal antibody; Mimotope peptide; Precise recognition; Peptide-based biomaterials; Biotransformation; Patient serum

Alina Nastke, Harald Gröger. (Chair of Industrial Organic Chemistry and Biotechnology, Faculty of Chemistry, Bielefeld University, Universitätsstr. 25, 33615 Bielefeld, Germany). Biotransformations with Imine Reductases: Design of a Practical Process Avoiding an Extractive Work-Up by Entrapment of Water and Enzymes in an Immobilized Phase. European Journal of Organic Chemistry (2023): e202300158

A process concept for the asymmetric biocatalytic reduction of heterocyclic imines addressing the efficiency of the reaction as well as downstream-processing steps was studied by utilizing a “heterogenized aqueous phase”, which contains the needed enzymes and cofactor within a superabsorber (polyacrylate) network, for the biotransformation. The immobilized biocatalytic system, which comprises an imine reductase (IRED), NADPH and an alcohol dehydrogenase for cofactor-recycling, enables to run the reaction in pure organic medium. Thus, instead of an extractive work-up as typical solution for biotransformations in aqueous medium, which, however, can be tedious due formation of emulsions, this type of IRED-catalyzed process leads to a simplified work-up consisting only of a decantation of the liquid organic reaction medium with the product from the heterogenized aqueous biocatalyst system. Exemplified for the (R)-enantioselective reduction of 1-methyl-3,4-dihydroisoquinoline by the IRED of Streptomyces viridochromogenes as a model reaction, a process was developed leading to 98 % conversion, 88 % yield and >99 % ee at a substrate concentration of 40 mM.

Keywords: biocatalysis; bioprocess development; imine reductases; reduction; superabsorber

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patients and healthy subjects. Chinese Journal of Natural Medicines, Volume 21, Issue 10 (2023): 723-729

Many natural products can be bio-converted by the gut microbiota to influence pertinent efficiency. Ginsenoside compound K (GCK) is a potential anti-type 2 diabetes (T2D) saponin, which is mainly bio-transformed into protopanaxadiol (PPD) by the gut microbiota. Studies have shown that the gut microbiota between diabetic patients and healthy subjects are significantly different. Herein, we aimed to characterize the biotransformation of GCK mediated by the gut microbiota from diabetic patients and healthy subjects. Based on 16S rRNA gene sequencing, the results indicated the bacterial profiles were considerably different between the two groups, especially Alistipes and Parabacteroides that increased in healthy subjects. The quantitative analysis of GCK and PPD showed that gut microbiota from the diabetic patients metabolized GCK slower than healthy subjects through liquid chromatography tandem mass spectrometry (LC-MS/MS). The selected strain A. finegoldii and P. merdae exhibited a different metabolic capability of GCK. In conclusion, the different biotransformation capacity for GCK may impact its anti-diabetic potency.

Keywords: Ginsenoside compound K; Gut microbiota; Biotransformation; Diabetes

Manxin Xu[a], Ge Zhang[a], Yang Qiu[a], Yongtao Li[ab], Churong Liu[a], Xingjian Yang[ab] (a. College of Natural Resources and Environment, Joint Institute for Environment & Education, South China Agricultural University, Guangzhou 510642, PR China, b. Guangdong Province Key Laboratory for Land Use and Consolidation, Guangzhou 510642, PR China). **Biotransformation of cyproterone acetate, drospirenone, and megestrol acetate in agricultural soils: Kinetics, microbial community dynamics, transformation products, and mechanisms. Science of The Total Environment, Volume 904 (2023): 166847**

The occurrence of biologically active synthetic progestins in agricultural soils is of growing concern due to their potential to disrupt the endocrine function of aquatic fish in nearby surface waters. This study investigated the biotransformation outcomes of cyproterone acetate (CPA), drospirenone (DRO), and megestrol acetate (MGA) in four agricultural soils. The biotransformation data were fitted to a first-order decay model (R2 = 0.93–0.99), with half-lives and first-order decay coefficients ranging from 76.2–217 h and 9.10 × 10−3–3.20 × 10−3 (h−1), respectively. Abundant biotransformation products (TPs) were generated during incubation, with the number and yields varying across the four soils. 1,2-Dehydrogenation was the main transformation pathway of DRO in the four soils (yields of 32.3–214 %). Similarly, 1,2-dehydrogenation was the most relevant transformation pathway of MGA in the four soils (yields of 21.8–417 %). C3 reduction was the major transformation pathway of CPA in soils B, C, and D (yields of 114–245 %). Hydrogenation (yield of 133 %) and hydroxylation (yield of 21.0 %) were the second major transformation pathway of CPA in soil B and C, respectively. In particular, several TPs exhibited progestogenic and antimineralocorticoid activity, as well as genotoxicity. The high-throughput sequencing indicated that interactions between microorganisms and soil properties may affect biotransformation. Spearman correlation and bidirectional network correlation analysis further revealed that soil properties can directly interfere with the soil sorption capacity for the progestins, thus affecting biotransformation. In particular, soil properties can also limit or promote biotransformation and the formation of TPs (i.e., biotransformation pathways) by affecting the relative abundances of relevant microorganisms. The results of this study indicate that the ecotoxicity of synthetic progestins and

related TPs can vary across soils and that the assessment of environmental risks associated with these compounds requires special consideration of both soil properties and microbial communities.

Keywords: Synthetic progestins; Biotransformation kinetics; Biotransformation products; Amplicon sequencing; Bidirectional correlation analysis

Kazuaki Takahashi[a], Sakie Horiai[b], Yoshikazu Yamagishi[c], Sayaka Nagasawa[c], Hirotaro Iwase[c], Yasumitsu Ogra[b] (a. Graduate School of Horticulture, Chiba University, 1-33 Yayoi Cho, Inage, Chiba 263-8522, Japan, b. Graduate School of Pharmaceutical Sciences, Chiba University, 1-8-1 Inohana, Chuo, Chiba 260-8675, Japan, c. Graduate School of Medicine, Chiba University, 1-8-1 Inohana, Chuo, Chiba 260-8670, Japan). **Biotransformation of se-methylselenocysteine into volatile selenocompounds by bacteria isolated from rat gut microflora. Journal of Functional Foods, Volume 110 (2023): 105859**

Selenium (Se) is an essential micronutrient that exists in various chemical forms in nature. Because of this property, animals must metabolize diverse Se species to utilize them as selenoproteins. Although gut microflora is suggested to play a role in Se metabolism in host animal, the biotransformation of Se by gut microflora in animal gut is not fully understood. In this study, we isolated Morganella morganii from rat feces under the condition that Se-methylseleno-L-cysteine (MeSeCys), one of the major Se sources in vegetables, was present in excess. Then, we examined the biotransformation of MeSeCys by M. morganii. Two volatile selenocompounds, dimethyldiselenide (DMDSe) and dimethylselenide (DMSe), were detected by GC–MS in the headspace of M. morganii culture. We speculate that M. morganii cleaved off the methylselenyl group from MeSeCys. Taken together, we conclude that gut microflora plays a role in the biotransformation of MeSeCys, and seems to support efficient metabolism in animals.

Keywords: Selenium; Dimethyldiselenide; Dimethylselenide; M. morganii; GC–MS; Gut microflora

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The application of mass spectrometry imaging (MSI) is a promising tool to analyze the spatial distribution of organic contaminants in organisms and thereby improve the understanding of toxicokinetic and toxicodynamic processes. MSI is a common method in medical research but has been rarely applied in environmental science. In the present study, the suitability of MSI to assess the spatial distribution of organic contaminants and their biotransformation products (BTPs) in the aquatic invertebrate key species Gammarus pulex was studied. Gammarids were exposed to a mixture of common organic contaminants (carbamazepine, citalopram, cyprodinil, efavirenz, fluopyram and terbutryn). The distribution of the parent compounds and their BTPs in the organisms was analyzed by two MSI methods (MALDI- and DESI-HRMSI) after cryo-sectioning, and by LC-HRMS/MS after dissection into different organ compartments. The spatial distribution of contaminats in gammarid tissue could be successfully analyzed by the different analytical methods. The intestinal system was identified as the main site of biotransformation, possibly due to the presence of biotransforming enzymes. LC-HRMS/MS was more sensitive

and provided higher confidence in BTP identification due to chromatographic separation and MS/MS. DESI was found to be the more sensitive MSI method for the analyzed contaminants, whereas additional biomarkers were found using MALDI. The results demonstrate the suitability of MSI for investigations on the spatial distribution of accumulated organic contaminants. However, both MSI methods required high exposure concentrations. Further improvements of ionization methods would be needed to address environmentally relevant concentrations.

Keywords: Aquatic invertebrates; Bioaccumulation; Cryosectioning; Dissection; Gammarus pulex; Micropollutants; Whole body cross sections

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This study examined the biotransformation of phytocannabinoids in human hepatocytes. The susceptibility of the tested compounds to transformations in hepatocytes exhibited the following hierarchy: cannabinol (CBN) > cannabigerol (CBG) > cannabichromene (CBC) > cannabidiol (CBD). Biotransformation included hydroxylation, oxidation to a carboxylic acid, dehydrogenation, hydrogenation, dehydration, loss/shortening of alkyl, glucuronidation and sulfation. CBN was primarily metabolized by oxidation of a methyl to a carboxylic acid group, while CBD, CBG and CBC were preferentially metabolized by direct glucuronidation. The study also screened for the activity of recombinant human cytochromes P450 (CYPs) and UDP-glucuronosyltransferases (UGTs), which could catalyze the hydroxylation and glucuronidation of the tested compounds, respectively. We found that CBD was hydroxylated mainly by CYPs 2C8, 2C19, 2D6; CBN by 1A2, 2C9, 2C19 and 2D6; and CBG by 2B6, 2C9, 2C19 and 2D6. CBC exhibited higher susceptibility to CYP-mediated transformation than the other tested compounds, mainly with CYPs 1A2, 2B6, 2C8, 2C19, 2D6 and 3A4 being involved. Further, CBD was primarily glucuronidated by UGTs 1A3, 1A7, 1A8, 1A9 and 2B7; CBN by 1A7, 1A8, 1A9 and 2B7; CBG by 1A3, 1A7, 1A8, 1A9, 2B4, 2B7 and 2B17; and the glucuronidation of CBC was catalyzed by UGTs 1A1, 1A8, 1A9 and 2B7.

Keywords: Cannabinoid; Human hepatocyte; CYP; UGT; Mass spectrometry; MS fragmentation

Biomarker

Sharmistha Majumder, Madhurima Joardar, Antara Das, Ayan De, Deepanjan Mridha, Swetanjana Ghosh, Urvashi Lama, Archita Dey, Nilanjana Roy Chowdhury, Arnab Majumdar, Tarit Roychowdhury. (School of Environmental Studies, Jadavpur University,

Kolkata, 700032, India). Arsenic toxicity, biomarkers of exposure and risk assessment among different aged young population from endemic areas of West Bengal, India. Groundwater for Sustainable Development, Volume 23 (2023): 101022

Arsenic exposure and associated risks in various age groups, including toddlers (1–6 years), children (7–11 years) and adolescents (12–17 years) have been evaluated through ingestion of drinking water (134 and 23.1 μg/l), rice grain (209 and 180 μg/kg) and vegetables (206 and 80.6 μg/kg) from two respective arsenic exposed villages namely Jamdani in Gaighata and Bade Khantura in Habra-I block from the North 24 Parganas district of West Bengal. 'Spearman correlation' found a significant association between arsenic intake particularly from drinking water and biomarkers exposure. Statistical analysis, employing 'ANOVA' followed by 'Bonferroni correction', demonstrated a strong correlation between age and arsenic deposition in biomarkers. Notably, age-dependent drop in urinary arsenic level and rise in hair and nail was observed among the studied age groups. Based on the SAMOE (Risk Thermometer), drinking water poses the highest risk for Jamdani (class 5) than Bade Khantura (class 4), while rice grains and vegetables both were classified as risk class 4 for the studied age groups. The cumulative estimated-daily-intakes (EDICumulative) of arsenic in central tendency exposure (CTE) for Jamdani and Bade Khantura were observed to be $1.09 \times 10{-}2$ and $2.7 \times 10{-}3$ mg/kg bw/day; $1.01 \times 10{-}2$ and $2.53 \times 10{-}3$ mg/kg bw/day; $9 \times 10{-}3$ and $2.46 \times 10{-}3$ mg/kg bw/day for respective age groups. Likewise, the EDICumulative for possible reasonable maximum exposure (RME) for two villages were observed to be $1.67 \times 10{-}2$ and $5.18 \times 10{-}3$ mg/kg bw/day; $1.56 \times 10{-}2$ and $4.91 \times 10{-}3$ mg/kg bw/day; $1.42 \times 10{-}3$ and $4.76 \times 10{-}3$ mg/kg bw/day for respective age groups. Furthermore, arsenic exposure was higher in all the age groups from Jamdani compared to Bade Khantura and calculated health risk (cancerous and non-cancerous) was more in toddlers followed by children and adolescents. It is highly recommended to prioritize the consumption of arsenic-safe drinking water and ensure access to a nutritious food supply to effectively combat the arsenic toxicity.

Keywords: Different age groups; Arsenic intake; Biomarkers deposition; CTE and RME scenarios; Health risk

Toshihiro Uemura, Atsunari Kawashima, Kentaro Jingushi, Daisuke Motooka, Takuro Saito, Sassi Nesrine, Toshiki Oka, Yohei Okuda, Akinaru Yamamoto, Gaku Yamamichi, Eisuke Tomiyama, Yu Ishizuya, Yoshiyuki Yamamoto, Taigo Kato, Koji Hatano, Kazutake Tsujikawa, Hisashi Wada, Norio Nonomura. ([a]Department of Urology, Osaka University, Graduate School of Medicine, 2-2 Yamadaoka, Suita, Osaka, 565-0871, Japan, [b]Laboratory of Molecular and Cellular Physiology, Graduate School of Pharmaceutical Sciences, Osaka University, 1-6 Yamadaoka, Suita, Osaka, 565-0871, Japan, [c]Department of Infection Metagenomics, Genome Information Research Center, Osaka University Research Institute for Microbial Diseases, Suita, Osaka, 565-0871, Japan, [d]Department of Surgery, Graduate School of Medicine, Osaka University, Suita, Osaka, 565-0871, Japan, [e]Department of Clinical Research in Tumor Immunology, Graduate School of Medicine, Osaka University, Suita, Osaka, 565-0871, Japan). Bacteria-derived DNA in serum extracellular vesicles are biomarkers for renal cell carcinoma. Heliyon, Volume 9, Issue 9 (2023): e19800

This is the first study to determine the clinical importance of circulating bacterial DNA in patients with renal cell carcinoma (RCC). We performed 16S rRNA metagenomic analysis of serum extracellular vesicles (EVs) from 88 patients with RCC and 10 healthy donors and identified three abundant bacterial DNA: Bacteroidia, TM7-1, and Sphingomonadales.

Combining characteristic bacterial DNA information (three bacteria-derived DNA), a BTS index was created to diagnose patients with RCC. The BTS index showed high sensitivity not only in the discovery cohort, but also in the validation cohort, suggesting that it was useful as a screening test. Furthermore, in nivolumab treatment of RCC, patients with higher levels of Bacteroidia DNA in serum EVs had significantly poorer progression-free and overall survival than did those with lower levels. This study showed that circulating Bacteria-derived DNA could be used as a biomarker for RCC.

Keywords: Biomarker

You-Rim Lee [a 1], Jiyeong Lee [b c 1], Hee-Gyoo Kang [a c d.] ([a]Department of Senior Healthcare, Graduate School, Eulji University, Uijeongbu, 11759, Republic of Korea, [b]Department of Biomedical Laboratory Science, College of Health Science, Eulji University, Uijeongbu, 11759, Republic of Korea, [c]Department of Biomedical Laboratory Science, Graduate School, Eulji University, Uijeongbu, 11759, Republic of Korea, [d]Department of Biomedical Laboratory Science, College of Health Sciences, Eulji University, Seongnam, 13135, Republic of Korea). Discovery and validation of a protein biomarker for the diagnosis and classification of disease severity of major depressive disorder. Clinica Chimica Acta, Volume 549(2023): 117555

Background and aims

Diagnosis and classification of disease severity of major depressive disorder (MDD) are determined through a doctor's consultation and questionnaire-based rating scale. This study aimed to identify and validate a serum protein biomarker for diagnosing and classifying the disease severity of MDD.

Materials and methods

Based on the Hamilton Depression Rating Scale (HAMD) score, participants were divided into control, mild, moderate, and severe groups. Samples prepared from collected sera were analyzed using non-targeted qualitative and targeted quantitative tools to identify potential biomarkers.

Results

Four proteins were selected as biomarker candidates, which showed statistically significant consistent tendencies depending on MDD severity. Among them, tetranectin was the only validated protein in the quantitative analysis that showed the same decreasing tendency as that in the qualitative analysis. Furthermore, tetranectin showed fair discrimination performance between the control and MDD group.

Conclusions

Tetranectin may be a novel potential biomarker for diagnosing and classifying the severity of MDD, though further verification and validation studies of its efficacy are needed

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matter sources, thermal maturation and depositional environment of the Devonian Pimenteiras Formation, Parnaíba Basin (Brazil). Geoenergy Science and Engineering, Volume 229 (2023): 212093

The potential for hydrocarbon generation of Devonian shales from Pimenteiras Formation has been the object of study in many research works. In this study, the focus is to evaluate the organic matter sources, thermal maturation and depositional environments of the Pimenteiras Formation based on aliphatic and aromatics biomarkers. Thereby, a total of 30 samples from three wells were analyzed using gas chromatography and mass spectrometry (GC/MS). The n-alkanes, isoprenoids, and terpanes data revealed that shales from Pimenteiras Formation results of a mixture of marine, transitional and terrestrial organic matter. These findings are consistent with C27, C28 and C29 steranes distribution and abundance of methylphenanthrene and methyldibenzothiophene. The Pr/n-C17 and Ph/n-C18 ratios in the BP-77 well are greater than 1.0 (immature), while the most samples from BP-59 and BP-22 wells, the Pr/n-C17 and Ph/n-C18 ratios are less than 1.0 (mature). Findings are consistent with CPI, M30/H30, S/(S + R) (C29 ααα) and C29 ββ/(αα+ββ ratios. Additionally, the Ts/(Ts + Tm) ratios, MPI-1 versus Ro, 2-MP, 3-MP, MPI-1, MPR-1, dimethylnaphthalenes and dimethyldibenzothiophene indicate that the organic matter varies from immature to mature, and reaches the overmature stage in terms of thermal maturity. The Pr/Ph ratio, Pr/n-C17 vs Ph/n-C18 plot, high H35/H34, C29/C30, C27 Dia/C27 ααα (R + S) ratios and high concentration of dibenzothiophene suggests that the organic matter was deposited under oxic, suboxic and anoxic conditions. On the other hand, the low abundance of gammacerane and low Gam/H30 ratio suggests a low salinity and/or water column stratification. Additionally, the data showed that the organic matter was deposited in marine, marine carbonate platform and terrestrial environments.

Keywords: Parnaíba basin; Pimenteiras formation; Biomarkers; Organic matter sources; Thermal maturation; Depositional environment

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Urban wastewater treatment plants (UWTPs) are essential for reducing the pollutants load and protecting water bodies. However, wastewater catchment areas and UWTPs emit continuously

antibiotic resistant bacteria (ARB) and antibiotic resistance genes (ARGs), with recognized impacts on the downstream environments. Recently, the European Commission recommended to monitor antibiotic resistance in UWTPs serving more than 100 000 population equivalents. Antibiotic resistance monitoring in environmental samples can be challenging. The expected complexity of these systems can jeopardize the interpretation capacity regarding, for instance, wastewater treatment efficiency, impacts of environmental contamination, or risks due to human exposure. Simplified monitoring frameworks will be essential for the successful implementation of analytical procedures, data analysis, and data sharing. This study aimed to test a set of biomarkers representative of ARG contamination, selected based on their frequent human association and, simultaneously, rare presence in pristine environments. In addition to the 16S rRNA gene, ten potential biomarkers (intI1, sul1, ermB, ermF, aph(3″)-Ib, qacEΔ1, uidA, mefC, tetX, and crAssphage) were monitored in DNA extracts (n = 116) from raw wastewater, activated sludge, treated wastewater, and surface water (upstream and downstream of UWTPs) samples collected in the Czech Republic, Denmark, Israel, the Netherlands, and Portugal. Each biomarker was sensitive enough to measure decreases (on average by up to 2.5 log-units gene copy/mL) from raw wastewater to surface water, with variations in the same order of magnitude as for the 16S rRNA gene. The use of the 10 biomarkers allowed the typing of water samples whose origin or quality could be predicted in a blind test. The results show that, based on appropriate biomarkers, qPCR can be used for a cost-effective and technically accessible approach to monitoring wastewater and the downstream environment.

Keywords: Quantitative PCR; Gene monitoring; Antibiotic resistance; Wastewater; Anthropogenic pollution

Anoop Sheshadri, Mason Lai, Fang-Chi Hsu, Scott R. Bauer, Shyh-Huei Chen, Warren Tse, Vasantha Jotwani, Gregory J. Tranah, Jennifer C. Lai, Stein Hallan, Roger A. Fielding, Christine Liu, Joachim H. Ix, Steven G. Coca, Michael G. Shlipak.. ([1]Department of Medicine, University of California San Francisco, San Francisco, CA, [2]Department of Medicine, San Francisco VA Health Care System, San Francisco, CA, [3]Department of Biostatistics and Data Science, Wake Forest University School of Medicine, Winston-Salem, NC, [4]California Pacific Medical Center, San Francisco, CA, United States, [5]Department of Clinical and Molecular Medicine, Norwegian University of Science and Technology, Trondheim, Norway, [6]Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts University, Boston, MA, [7]Department of Medicine, Stanford University School of Medicine, Stanford, CA, [8]Geriatric Research Education and Clinical Center, Palo Alto VA Health Care System, Palo Alto, CA, [9]Department of Medicine, University of California San Diego, La Jolla, CA, [10]Department of Internal Medicine, Icahn School of Medicine at Mount Sinai, New York, NY). Structured Moderate Exercise and Biomarkers of Kidney Health in Sedentary Older Adults: The Lifestyle Interventions and Independence for Elders Randomized Clinical Trial. Kidney Medicine, Volume 5, Issue 11 (2023): 100721

Rationale & Objective In the Lifestyle Interventions and Independence for Elders (LIFE) trial, a structured exercise intervention slowed kidney function decline in sedentary older adults. Biomarkers of kidney health could distinguish potential mechanisms for this beneficial effect.

Study Design: Randomized controlled trial.

Setting & Population: A total of 1,381 sedentary adults aged 70-89 years enrolled in the LIFE trial.

Intervention: Structured, 2-year, moderate-intensity exercise intervention versus health education.

Outcomes: Physical activity was measured by step count. Primary outcomes were changes in 14 serum and urine biomarkers of kidney health collected at baseline, year 1, and year 2. We determined the effect of randomization on changes in kidney measures and then evaluated observational associations of achieved activity on each measure.

Results: Participants assigned to exercise walked on average 291 more steps per day than participants assigned to health education. The intervention was not significantly associated with changes in biomarkers of kidney health. In observational analyses, persons in the highest versus lowest quartile of activity (≥3,470 vs<1,568 steps/day) had significant improvement in urine albumin (mean, −0.22mg albumin/g urine creatinine [interquartile range (IQR), −0.37 to−0.06]), alpha-1-microglobulin (−0.18mg/L [−0.28 to−0.08]), trefoil factor-3 (−0.24pg/mL [−0.35 to−0.13]), epidermal growth factor (0.19pg/mL [0.06-0.32]), uromodulin (0.06pg/mL [0.00-0.12]), interleukin 18 (−0.09pg/mL [−0.15 to−0.03]), neutrophil gelatinase-associated lipocalin (−0.16pg/mL [−0.24 to−0.07]), monocyte chemoattractant protein-1 (−0.25pg/mL [−0.36 to−0.14]), clusterin (-0.16pg/mL [−0.30 to−0.02]), serum tumor necrosis factor receptor-1 (−0.25mg/dL [−0.39 to−0.11]) and tumor necrosis factor receptor-2 (−0.30mg/dL [−0.44 to−0.16]). In sensitivity analyses, incremental changes in activity were most impactful on urine interleukin 18 and serum tumor necrosis factor-1.

Limitations: The original study was not designed to assess the impact on kidney health. Non-white individuals and patients with advanced chronic kidney disease are underrepresented.

Conclusions: Randomization to structured exercise did not improve kidney health at a group level. However, higher exercise was associated with concurrent improvements in biomarkers of glomerular injury, tubular function/repair, tubular injury, generalized inflammation, and tubulointerstitial repair/fibrosis.

Plain-Language Summary: In the Lifestyle Interventions For Elders (LIFE) study, randomization to an exercise and physical activity intervention improved the slope of estimated glomerular filtration rate over 2 years compared with health education among older adults. In this study, we sought to determine whether there were specific biomarkers of kidney health that were affected by the exercise and physical activity intervention to investigate potential mechanisms for this positive impact on kidney decline. We found that randomization to the intervention did not improve any of the 14 measures of kidney tubule health. However, in observational analyses, higher activity was independently associated with improvements in several domains, especially tubular injury and generalized inflammation. These results help to clarify the impact of physical activity on kidney health.

Keywords: Biomarkers; kidney health; exercise; physical activity; older adults

Mustapha Agnaou [a b], Youssef El Mourabit[a], Meryam Nadir [a b], Jaouad Abou Oualid [a], Karima ELmchichi [a], Karim Sahla [a], Latifa Lefrere [a b], Ali Banaoui [a], Aicha Ait Alla [a]. ([a]Laboratory of "Aquatic Systems: Marine and Continental Ecosystems", Ibn Zohr University, Agadir, Morocco, [b]Faculty of Applied Sciences, Ait Melloul, Morocco).
Integrated Biomarker responses in the mollusk, *Patella vulgata*: Assessing Aquatic pollution in Agadir Bay, South Morocco. Marine Pollution Bulletin, Volume 196 (2023): 115660

In Agadir Bay, a study evaluated pollution biomarkers in the mollusk species Patella vulgata. Samples were collected seasonally from September 2021 to September 2022 at two distinct coastal sites within Agadir Bay: Cap Ghir and Anza Beach. Notable variations were observed in biomarkers like malondialdehyde, with a peak at 10.62 nmol/mg P in spring 2022 at Anza Beach. Catalase activity spiked in spring at 69.56 µmol/min/mg P for Cap Ghir and 72.73 µmol/min/mg P for Anza Beach. Acetylcholinesterase showed a decrease at 9.84 nmol/min/mg P in autumn at Anza Beach. Meanwhile, glutathione-S-transferase recorded an increase to 317.96 nmol/min/mg P at Cap Ghir in spring 2022. Using the Integrated Biomarker Response (IBR), these results were visualized, highlighting more stress in mollusks from Anza Beach compared to Cap Ghir. This research provides critical insights into the environmental effects on *P. vulgata* and potential conservation strategies.

Sandra Hoyek [a], Natasha F.S. da Cruz [b], Nimesh A. Patel [a], Hasenin Al-Khersan [b], Kenneth C. Fan [b], Audina M. Berrocal [b]. ([a]Department of Ophthalmology, Massachusetts Eye and Ear, Harvard Medical School, Boston, MA, USA, [b]Bascom Palmer Eye Institute, University of Miami Leonard M. Miller School of Medicine, Miami, FL, USA). **Identification of novel biomarkers for retinopathy of prematurity in preterm infants by use of innovative technologies and artificial intelligence. Progress in Retinal and Eye Research, Volume 97(2023): 101208**

Retinopathy of prematurity (ROP) is a leading cause of preventable vision loss in preterm infants. While appropriate screening is crucial for early identification and treatment of ROP, current screening guidelines remain limited by inter-examiner variability in screening modalities, absence of local protocol for ROP screening in some settings, a paucity of resources and an increased survival of younger and smaller infants. This review summarizes the advancements and challenges of current innovative technologies, artificial intelligence (AI), and predictive biomarkers for the diagnosis and management of ROP. We provide a contemporary overview of AI-based models for detection of ROP, its severity, progression, and response to treatment. To address the transition from experimental settings to real-world clinical practice, challenges to the clinical implementation of AI for ROP are reviewed and potential solutions are proposed. The use of optical coherence tomography (OCT) and OCT angiography (OCTA) technology is also explored, providing evaluation of subclinical ROP characteristics that are often imperceptible on fundus examination. Furthermore, we explore several potential biomarkers to reduce the need for invasive procedures, to enhance diagnostic accuracy and treatment efficacy. Finally, we emphasize the need of a symbiotic integration of biologic and imaging biomarkers and AI in ROP screening, where the robustness of biomarkers in early disease detection is complemented by the predictive precision of AI algorithms.

Aline H. de Nooijer [a b c], Peter Pickkers [b c], Mihai G. Netea [a c d], Matthijs Kox [b c]. ([a]Department of Internal Medicine, Radboud University Medical Center, 6500 HB Nijmegen, the Netherlands, [b]Department of Intensive Care Medicine, Radboud University Medical Center, 6500 HB Nijmegen, the Netherlands, [c]Radboud University Medical Center for Infectious Diseases, Radboud University Medical Center, 6500 HB Nijmegen, the Netherlands, [d]Department of Immunology and Metabolism, Life & Medical Sciences Institute, University of Bonn, 53115 Bonn, Germany). **Inflammatory biomarkers to predict the prognosis of acute bacterial and viral infections. Journal of Critical Care, Volume 78 (2023): 154360**

Mortality in acute infections is mostly associated with sepsis, defined as '*life-threatening organ dysfunction caused by a dysregulated host response to infection*'. It remains challenging to identify the patients with increased mortality risk due to the high heterogeneity in the dysregulated host immune response and disease progression. Biomarkers reflecting different pathways involved in the inflammatory response might improve prediction of mortality risk (prognostic enrichment) among patients with acute infections by reducing heterogeneity of the host response, as well as suggest novel strategies for patient stratification and treatment (predictive enrichment) through precision medicine approaches. The predictive value of inflammatory biomarkers has been extensively investigated in bacterial infections and the recent COVID-19 pandemic caused an increased interest in inflammatory biomarkers in this viral infection. However, limited research investigated whether the prognostic potential of these biomarkers differs between bacterial and viral infections. In this narrative review, we provide an overview of the value of various inflammatory biomarkers for the prediction of mortality in bacterial and viral infections.

Keywords: Biomarker; Inflammation; Prognostication; Mortality; Sepsis; COVID-19

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Volume 547 (2023): 117437

Depressive disorders belong to highly heterogeneous psychiatric diseases. Loss of in interest in previously enjoyed activities and a depressed mood are the main characteristics of major depressive disorder (MDD). Moreover, due to significant heterogeneity in clinical presentation and lack of applicable biomarkers, diagnosis and treatment remains challenging. Identification of relevant biomarkers would allow for improved disease classification and more personalized treatment strategies. Herein, we review the current state of these biomarkers and then discuss diagnostic techniques of aimed to specifically target these analytes using state of the art biosensor technology.

Elizabeth A. Kiernan, David Hu, Heather Thiessen Philbrook, Joachim H. Ix, Joseph V. Bonventre, Steven G. Coca, Dennis G. Moledina, Linda F. Fried, Michael G. Shlipak, Chirag R. Parikh. ([1]Division of Nephrology, Department of Medicine, School of Medicine, Johns Hopkins University, Baltimore, Maryland, [2]Division of Nephrology-Hypertension, University of California–San Diego, San Diego, California, [3]Veterans Affairs San Diego Healthcare System, San Diego, CA, [4]Kidney Health Research Collaborative, Department of Medicine, University of California–San Francisco, San Francisco, California, [5]Renal Division, Brigham & Women's Hospital, Boston, Massachusetts, [6]Division of Nephrology, Department of Medicine, Icahn School of Medicine at Mount Sinai, New York, New York, [7]Section of Nephrology and Clinical and Translational Research Accelerator, Department of Internal Medicine, School of Medicine, Yale University, New Haven, Connecticut, [8]Renal Section, Veterans Affairs Pittsburgh Healthcare System, Pittsburgh, Pennsylvania). **Urinary Biomarkers and Kidney Injury in VA NEPHRON-D: Phenotyping Acute Kidney**

Injury in Clinical Trials. American Journal of Kidney Diseases Volume 83, Issue 2 (2023): 151-161

Rationale & Objective: Urinary biomarkers of injury, inflammation, and repair may help phenotype acute kidney injury (AKI) observed in clinical trials. We evaluated the differences in biomarkers between participants randomized to monotherapy or to combination renin-angiotensin-aldosterone system (RAAS) blockade in VA NEPHRON-D, where an increased proportion of observed AKI was acknowledged in the combination arm.

Study Design: Longitudinal analysis.

Setting & Participants: A substudy of the VA NEPHRON-D trial.

Predictor: Primary exposure was the treatment arm (combination [RAAS inhibitor] vs monotherapy). AKI is used as a stratifying variable.

Outcome: Urinary biomarkers, including albumin, EGF (epidermal growth factor), MCP-1 (monocyte chemoattractant protein-1), YKL-40 (chitinase 3-like protein 1), and KIM-1 (kidney injury molecule-1).

Analytical Approach: Biomarkers measured at baseline and at 12 months in trial participants were compared between treatment groups and by AKI. AKI events occurring during hospitalization were predefined safety end points in the original trial. The results were included in a meta-analysis with other large chronic kidney disease trials to assess global trends in biomarker changes.

Results: In 707 participants followed for a median of 2.2 years, AKI incidence was higher in the combination (20.7%) versus the monotherapy group (12.7%; relative risk [RR], 1.64 [95% CI, 1.16-2.30]). Compared with the monotherapy arm, in the combination arm the urine biomarkers at 12 months were either unchanged (MCP-1: RR, −3% [95% CI, −13% to 9%], Padj=0.8; KIM-1: RR, −10% [95% CI, −20% to 1%], Padj=0.2; EGF, RR−7% [95% CI, −12% to−1%], Padj=0.08) or lower (albuminuria: RR, −24% [95% CI, −37% to−8%], Padj=0.02; YKL: RR, −40% to−44% [95% CI, −58% to−25%], Padj<0.001). Pooled meta-analysis demonstrated reduced albuminuria in the intervention arm across 3 trials and similar trajectories in other biomarkers.

Limitations: Biomarker measurement was limited to 2 time points independent of AKI events.

Conclusions: Despite the increased risk of serum creatinine–defined AKI, combination RAAS inhibitor therapy was associated with unchanged or decreased urinary biomarkers at 12 months. This suggests a possible role for kidney biomarkers to further characterize kidney injury in clinical trials.

Plain-Language SummaryL: The VA NEPHRON-D trial investigated inhibition of the renin-angiotensin-aldosterone system (RAAS) hormonal axis on kidney outcomes in a large population of diabetic chronic kidney disease patients. The trial was stopped early due to increased events of serum creatinine–defined acute kidney injury in the combination therapy arm. Urine biomarkers can serve as an adjunct to serum creatinine in identifying kidney injury. We found that urinary biomarkers in the combination therapy group were not associated with a pattern of harm and damage to the kidney, despite the increased number of kidney injury events in that group. This suggests that serum creatinine alone may be insufficient for defining kidney injury

and supports further exploration of how other biomarkers might improve identification of kidney injury in clinical trials.

Keywords: AKI; albuminuria; biomarkers; creatinine; RAAS-I

Biofertilizer

Xian Zhou[ab], Bangxing Lei[a], Deliang Yin[ab], Jichuan Kang[a], Zhangjiang He[a], Tianrong He[a], Xiaohang Xu[a]. (a. Engineering Research Center for Southwest Bio-Pharmaceutical Resources, Key Laboratory of Karst Georesources and Environment, Guizhou Karst Environmental Ecosystems Observation and Research Station, Ministry of Education, Guizhou University, Guiyang, 550025, China, b. College of Resources and Environment Engineering, Guizhou University, Guiyang, 550025, China). Application potential of biofertilizer-assisted Pennisetum giganteum in safe utilization of mercury-contaminated paddy fields. Journal of Environmental Management, Volume 348 (2023): 119291

High mercury (Hg) bioaccumulation in crops such as rice in Hg-contaminated areas presents a potential health hazard to humans and wildlife. To develop a safe alternative technique, bacillus-inoculated biofertilizer, citric acid, earthworms, and selenium-modified activated clay were compared for their ability to regulate Hg bioaccumulation in Pennisetum giganteum (P. giganteum). This biofertilizer significantly increased Bacillus sp. abundance in the soil by 157.12%, resulting in the removal of 27.52% of water-soluble Hg fractions through volatilization and adsorption mechanisms. The variation in bioavailable Hg in the soil significantly reduced the total Hg concentration in P. giganteum young leaves, old leaves, stems, and roots of P. giganteum by 74.14%, 48.08%, 93.72%, and 50.91%, respectively ($p < 0.05$), which is lower than the Chinese feed safety standard (100 ng g−1). The biofertilizer inhibitory potential was highly consistent with that of the selenium-modified activated clay. Biofertilizers significantly reduced the methylmercury concentration in various P. giganteum tissues ($p < 0.05$), whereas selenium-modified activated clay failed to achieve a comparable effect. This biofertilizer-assisted planting pattern can achieve an economic income quadruple that of the rice planting pattern in the Hg-contaminated paddy fields. Because of its significant environmental and financial applications, the biofertilizer-assisted planting pattern is expected to replace Hg-contaminated paddy fields.

Keywords: Safe utilization; Mercury; Modifier; Phytoremediation; Agricultural output

Shaibi Saleem, Abdul Malik, Shams Tabrez Khan. (Department of Agricultural Microbiology; Faculty of Agricultural Sciences; Aligarh Muslim University, Aligarh 202002, Uttar Pradesh, India). ZnO nanoparticles in combination with Zn biofertilizer improve wheat plant growth and grain Zn content without significantly changing the rhizospheric microbiome. Environmental and Experimental Botany, Volume 213 (2023): 105446

Zinc-deficient diet and poor bioavailability are leading to Zn deficiency a major form of hidden hunger affecting millions across the globe with significant economic and health consequences. Agronomic Zn-fortification of cereals using Zn-solubilizing bacteria based biofertilizers (Zn biofertilizer) can be an effective, economic, and socially acceptable solution. This field study explores the prospect of using a combination of ZnO-nanoparticles (5 kg ha-1) with Zn-biofertilizer (20 g kg-1 of seeds) for agronomic fortification of wheat. Culture-dependent

technique and Illumina sequencing were used to evaluate the shift in soil microbial community in response to these amendments. The change in vegetative growth of wheat (Triticum aestivum) plant and grain Zn-content was also monitored. The results were compared with those obtained with bulk ZnO amendment. In the presence of ZnO-NPs and biofertilizer the total length, fresh weight, dry weight, chlorophyll, and carotenoid content increased by 14.6 %, 37.5 %, 40 %, 30.9 %, and 31.7 %, respectively, compared to control indicating a significant improvement in plant growth. The grain's protein, grain yield, and Zn content increased by 30.74 %, 8.8 %, and 66.3 %, respectively. The total aerobic bacteria, fungal count, N2-fixing bacteria, phosphate solubilizers, and Zn-solubilizing bacteria increased by 99, 34, 31, 166, and 1400 %, respectively. While the population of actinobacteria remained unchanged. The Illumina sequence analysis shows an increase in the population of bacteria belonging to the phylum Bacillota and Pseudomonadota, and genera like Bacillus, Masillia, and Rhizobium indicating a shift towards plant growth promotion. Alpha diversity indices and ordination analysis do not indicate any significant change in the microbial community. Results presented in this study indicate that the soil amendment with a combination of Zn-biofertilizer and ZnO-nanoparticles significantly promotes plant growth and improve grain Zn-content without significantly shifting microbial community structure.

Keywords: Zinc oxide nanoparticles; Soil microbial community; Triticum aestivum; Biofertilizer survival; Zinc solubilizing bacteria; PGP activity; Illumina sequencing

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Although there are several studies on the hydrothermal carbonization of microalgae biomass for value-added products and their potential environmental impacts, the feasibility of scaling-up and the environmental and economic analysis need to be investigated. This study produced solid biofuel and biofertilizer under two operating conditions (170 °C, 10 min, 7 bar; or 130 °C, 50 min, 2 bar, respectively). Also, investigated the environmental performance and techno-economical viability of producing solid biofuel and biofertilizer from microalgae. Scale-up modeling used Aspen Plus software to obtain optimized production processes, energy data, equipment requirements, and costs, which were used to support the economic and environmental analyses. The Recipe Midpoint method showed that the solid biofuel had a higher environmental impact than the biofertilizer, especially in the Freshwater Eutrophication category (almost 7 times higher), Fossil Resource Scarcity (4.2 times higher), Global Warming, and Marine Ecotoxicity (both around 2.7 times higher). The damage assessment results showed that the production of solid biofuel was more impactful, with Human Health impacts 2 times higher, Ecosystem 1.6 times higher, and Resource 4.3 times higher than those caused by biofertilizer production. The biofertilizer production scenario emerged as the most economically viable option for hydrothermal carbonization valorization. The negative net present value and the inability to achieve the return on investment within a 30-year timeframe made the solid biofuel production scenario unviable. Thus, biofertilizer production from hydrothermal carbonization of

microalgae biomass cultivated in wastewater is technically, economically, and environmentally feasible, whereas the same cannot be said for the biofuel evaluated.

Keywords: Hydrothermal carbonization; Bioenergy; Sustainability; Nutrient recovery; Wastewater treatment; Hydrochar

Yongqi Zhu[a], Mengjie An[a], Reyim Mamut[a], Haijiang Wang[b]. (a. Key Laboratory of Biological Resources and Genetic Engineering of Xinjiang Uygur Autonomous Region, College of Life Science & Technology, Xinjiang University, Urumqi, Xinjiang, 830046, PR China, b. Agricultural College, Shihezi University, Shihezi, Xinjiang, 832000, PR China). Comparative analysis of metabolic mechanisms in the remediation of Cd-polluted alkaline soil in cotton field by biochar and biofertilizer. Chemosphere, Volume 340 (2023): 139961

To screen environmentally friendly and efficient Cd pollution remediation material, the effects of BC and BF on soil Cd bio-availability and cotton Cd absorption were analyzed under Cd exposure. Besides, the differences in metabolic mechanisms by which biochar (BC) and biofertilizer (BF) affect Cd-contaminated soil and cotton were also analyzed. The results showed that the application of BC and BF increased cotton dry matter accumulation, boll number, and single boll weight, and reduced the Cd content in cotton roots, stems, leaves, and bolls. At harvest, the Cd content in cotton roots in the BC and BF groups reduced by 15.23% and 16.33%, respectively, compared with that in the control. This was attributed to the conversion of carbonate-bound Cd (carbon-Cd) and exchangeable Cd (EX-Cd) by BC and BF into residual Cd (Res-Cd). It should be noted that the soil available Cd (Ava-Cd) content in the BF group was lower than that in the BC group. The metabolomic analysis results showed that for BC vs BF, the relative abundance of differential metabolites Caffeic acid, Xanthurenic acid, and Shikimic acid in soil and cotton roots were up-regulated. Mantel test found that cotton root exudate l-Histinine was correlated with the enrichment of Cd in various organs of cotton. Therefore, the application of BC and BF can alleviate Cd stress by reducing soil Ava-Cd content and cotton's Cd uptake, and BF is superior to BC in reducing Cd content in soil and cotton organs. This study will provide a reference for the development of efficient techniques for the remediation of Cd-polluted alkaline soil, and provide a basis for subsequent metagenomics analysis.

Keywords: L-Histidine; Colenic acid; Cotton growth; Modifier; Bio-availability

Dikonketso Shirleymay Matjuda[ab], Memory Tekere[b], Mary-Jane Thaela-Chimuka[cd]. ([a]Agricultural Research Council-Animal Production (ARC-AP), Department of Microbiology and Biotechnology, Old Olifantsfontein Road, Private Bag X2, Irene, 0062, South Africa, [b]Department of Environmental Science, College of Agriculture, and Environmental Sciences (CAES), University of South Africa (UNISA), P.O. Box 392, Florida, 1710, South Africa, [c]Agricultural Research Council-Animal Production (ARC-AP), Animal Nutrition and Aquaculture, Old Olifantsfontein Road, Private Bag X2, Irene, 0062, South Africa, [d]School of Animal, Plant and Environmental Sciences, University of the Witwatersrand, Private bag 3, Wits, Braamfontein, 2050, Johannesburg, South Africa). Characterization of the physicochemical composition of anaerobically digested (digestate) high throughput red meat abattoir waste in South Africa and the determination of its quality as a potential biofertilizer. Helicon, Volume 9, Issue 11 (2023): e21647

Anaerobic digestion as a treatment option for waste produced in high throughput red meat abattoirs in South Africa is now gaining interest in both private and government sectors. The resultant digested slurry (digestate) is currently being regarded as waste despite its nutritional value for soil and plants which can be harnessed if digestate is utilized as biofertilizer to ensure nutrient cycling. The study investigated the physicochemical and microbial characteristics of

digestate emanating from anaerobic digestion of red meat abattoir waste in South Africa, as well as evaluating its potential use as biofertilizer. The pH, total solids, volatile solids, chemical oxygen demand, electrical conductivity, total volatile fatty acids and chemical composition were determined using standard methods. Microbial analyses were determined according to the serial dilution method (101- 1010). The results were benchmarked with Public Available Specifications (PAS) 110 standards for quality control of digestate intended to be used as biofertilizer for agricultural purposes. Results for pH, total solids, electrical conductivity, chemical oxygen demand, and total volatile fatty acids fell within the required PAS110 standard which requires standard limits of 6.5–9, 30 %–50 %, <1500 mg/L, <3000 μS/cm, and 0.43 COD/g VS respectively. Moisture content in all red meat abattoir digestate ranged from 92.05 ± 0.5 % to 95.49 ± 0.38 % and did not meet the required limit of <35 %. E. coli in untreated cattle and pig abattoir digestate were 1023 ± 35 cfu/mL and 1068 ± 51 cfu/mL, respectively, and also did not meet the required standard limit of <1000 cfu/mL. Chemical composition showed that abattoir digestate was abundant in both macronutrients and micronutrients, and heavy metal concentrations in all digestate samples fell within the PAS 110. In conclusion, abattoir digestate was observed to be highly abundant in nutrients essential for soil health and plant growth, and mostly met the required EU PAS110 standard for utilization as biofertilizer in agricultural land.

Keywords: Digestate; biofertilizer; Red meat; Abattoir waste; Anaerobic digestion; High throughput

Yi-Xin Zhang[a], Yong-Xin Li[a], Wei Zhang[ab], Yun Niu[a], Raymond Jianxiong Zeng[a]. (a. Centre of Wastewater Resource Recovery, College of Resources and Environment, Fujian Agriculture and Forestry University, Fuzhou, 350002, China, b. College of Resources and Environment, Anhui Agricultural University, Hefei, China). Enrichment of biofertilizer-type hydrogen-oxidizing bacteria on urea containing Cu(II). Environmental Research, Volume 236, Part 2 (2023): 116831

With the utilization of pesticides and fertilizers (e.g. urea), the presence of nitrogen and heavy metals (e.g. copper) can enter and pollute the environment. Biofertilizers can be used to replace chemical fertilizers to increase crop yields and reduce environmental stress. The utilization of hydrogen-oxidizing bacteria (HOB) to be biofertilizers has recently attracted more attention. However, the enrichment of HOB on urea and the effect of copper are undetermined. HOB were successfully enriched using urea in this investigation. The average urea conversion rate (AUCR) was 180.08 mgN/L/d with a hydraulic retention time of 10 h. Microbial community (R1) was dominated by Hydrogenophaga (83.92%), a biofertilizer-type HOB. After addition of 5.47 mg/L Cu2+, the AUCR was decreased by 16%–151.18 mgN/L/d, and the growth of HOB was inhibited by 48%. Meanwhile, inhibition was also reflected by the increase of polysaccharide content (20.27 ± 0.57 to 33.45 ± 2.53 mg/gVSS) and protein content (106.19 ± 19.39 to 125.14 ± 24.73 mg/gVSS) of extracellular polymeric substances in the HOB. The resulting microbial community (R2) was changed to Azospiralium-dominated flora (91.33%). Both enriched microbial communities (R1 and R2) exhibited the abilities of ACC degradation and phosphate solubilization. This study demonstrates that employing urea can directly enrich biofertilizer-type HOB and copper-tolerant HOB can be obtained in a 5.47 mg/L Cu2+ environment. The results provide potential methods to obtain biofertilizer from copper-containing urea wastewater via HOB.

Keywords: Hydrogen-oxidizing bacteria; Urea wastewater; Copper ions; Biofertilizer; Enrichment

Lisheng Qian[a], Muhammad Zakriya[b], Mahnoor Pervez[c], Iram Waqar[d], Zhihua Song[e], Uzma Younis[f], Niaz Ahmed[g], Muhammad Azeem[g], Abdullah A. Alarfaj[h], Muhammad Iftikhar Hussain[i] (a. College of Life and Health Science, Anhui Science and Technology University, Fengyang 233100, China, b. Primary and Secondary Health Care Department Punjab, Pakistan, c. Department of Zoology, Lahore College for Women University Lahore, d. Department of Biotechnology, Lahore College for Women University Lahore, Punjab, Pakistan, e. College of Food Science, Anhui Science and Technology University, Fengyang 233100, China, f. Botany Department, The Islamia University of Bahawalpur, Sub-Campus Rahim Yar Khan, Rahim Yar Khan, Punjab, Pakistan, g. Department of Soil Science, Faculty of Agricultural Sciences and Technology, Bahauddin Zakariya University, Multan, Punjab, Pakistan, h. Department of Botany and Microbiology, College of Science, King Saud University, P. O. Box.2455, Riyadh 11451, Saudi Arabia, i. Department of Plant Biology & Soil Science, Universidad de Vigo, Campus Lagoas Marcosende, 36310 Vigo, Spain). Assessing the synergistic effect of acidified carbon, inorganic fertilizer, and biofertilizer on fenugreek antioxidant levels, and quality traits. Journal of King Saud University - Science, Volume 35, Issue 7 (2023): 102848

The use of inorganic fertilizers has become increasingly necessary due to the depletion of soil fertility. Inadequate nutrient levels in both plants and soil can be remedied with the application of fertilizers. However, to achieve optimal results, it is recommended to supplement inorganic fertilizers with organic alternatives such as biochar. Despite its benefits, the high pH of activated carbon presents a significant challenge to its use in alkaline soil. Recent studies have shown that acidified carbon can be used instead of alkaline activated carbon. Moreover, the use of biofertilizers is crucial for maintaining soil quality. The purpose of the current study was to investigate the effects of using biofertilizers, inorganic nitrogen fertilizer, and acidified carbon fertilizer in combination on fenugreek growth and chlorophyll concentrations. A pot experiment was conducted using calcium ammonium nitrate (CAN) and three levels of acidified carbon (BC) at 0, 0.75, and 1.50%, with and without the addition of biofertilizer (BF). The results revealed that 1.50CANBC + BF was the most effective supplement for improving soil characteristics such as pH, EC, and overall organic matter. The application of 0.75CANBC + BF was found to be a successful treatment for promoting fenugreek growth and enhancing nitrogen absorption. To achieve better fenugreek quality by reducing electrolyte leakage and MDA, and increasing chlorophyll levels, gardeners are advised to use 1.50CANBC + BF. However, to establish 1.50CANBC + BF as the optimal method for fenugreek growth in poor fertility and high pH soils, further experimental studies in various agro-climatic conditions are necessary.

Keywords: Acidified carbon; Inorganic fertilizer; Biofertilizer; Fenugreek; Chlorophyll concentration; Growth characteristics

Bangxin Ding[a], Hongxia Cao[a], Jianghui Zhang[b], Yungang Bai[b], Zijian He[a], Shuchen Guo[a], Bei Wang[b], Zila Jia[b], Hongbo Liu[b] (a. Key Laboratory of Agricultural Soil and Water Engineering in Arid and Semiarid Areas, Ministry of Education, Northwest A&F University, Yangling 712100, Shaanxi, China, b. Xinjiang Institute of Water Resources and Hydropower Research, Urumqi 830049, Xinjiang, China). Biofertilizer application improved cotton growth, nitrogen use efficiency, and yield in saline water drip-irrigated cotton fields in Xinjiang, China. Industrial Crops and Products, Volume 205 (2023): 117553

Saline water irrigation presents a potential solution for addressing freshwater shortages. However, this practice can result in salinity stress for cotton plants. Hence, it is imperative to explore measures that can alleviate salinity stress when implementing saline water irrigation. The aim of this study was to determine the effects of biofertilizer (F2) application on cotton growth, nitrogen use efficiency, yield, and fiber quality under different water: 0.48–1 g L−1 (W1, freshwater), 3 g L−1 (W2, brackish), and 7 g L−1 (W3, salt water) irrigation, compared to the use of chemical fertilizer (F1) alone. A two-year field experiment was conducted in 2021 and 2022 in film-mulched drip-irrigated cotton fields. The results showed that biofertilizers significantly enhance photosynthesis and N utilization efficiency under both W1 and W2 irrigation, compared to treatments where chemical fertilizers were applied alone. At the same time, the cotton total biomass, and cotton fiber elongation were significantly increased, and the cotton seed yield was significantly increased by 6.15–10.56 % (W1) and 6.49–11.81 % (W2) in two years. The application of biofertilizers indirectly increases cotton yield by enhancing cotton biomass and improving N utilization. In conclusion, the application of biofertilizer can effectively alleviate the salinity stress on plants in both W1 and W2 irrigation situations. Future research on saline water irrigation should take into account the long-term effects of using biofertilizers in saline irrigation situations.

Keywords: Saline water; Biofertilizer; Drip irrigation; Cotton field; Nitrogen use efficiency

Biocomposting

Gourisankar Pradhan, Ram Swaroop Meena. (Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, UP, 221 005, India). Interaction impact of biocompost on nutrient dynamics and relations with soil biota, carbon fractions index, societal value of CO_2 equivalent and ecosystem services in the wheat-rice farming. Chemosphere, Volume 339 (2023): 139695

This experiment aimed to understand the recycled industrial biocompost interaction with fertilizers doses on soil nutrient dynamics, soil organic carbon (SOC) fraction indexes, microbial population, positive ecosystem services, carbon dioxide (CO_2) societal values and economy in wheat (Triticum aestivum L.)–rice (Oryza sativa L.) production. Based on the field and lab data, a significant interaction was observed between the biocompost and fertilizer levels; the fertilizer doses (FD)3 × biocompost (BC)1 were observed 80.6 grain and 56.0% higher straw yield in the wheat-rice crops than FD0 × BC9. Based on the results of soil organic carbon (SOC), the treatment FD3 × BC1 was observed more very labile (5.06 g kg−1) and moderately labile (4.26 g kg−1) carbon (C) fractions. However, C liability and recalcitrant indexes were recorded as non-significant. Further, the interaction effects of FD3 × BC1 found 65.7% more CO_2 sequestration over FD0 × BC9. In terms of microbial dynamics, at 45 days after sowing (DAS), the treatment FD3 × BC4 was found to be the highest soil bacteria (56.6 × 107), fungi (32.3 × 105), and actinomycetes (49.1 × 106 cfu g−1) population. Further, regarding ecosystem services, the FD3 × BC1 found a maximum of US$ 1236 and 322 ha−1 year−1 grain and straw-based ecosystem services, respectively. However, the treatment FD3 × BC1 observed the maximum societal value (US$ 2041 ha−1). In contrast, higher economic values of 77.9 and 138.8% gross and net returns were recorded in the FD3 × BC1 compared to FD0 × BC9 in the

wheat-rice cropping sequence (WRCS), respectively. Therefore, the study's hypothesis was to know the impact of the biocompost with fertilizers doses to enhance the nutrient and microbial dynamics, increasing SOC fractions (active and passive) and pools, CO2 sequestration, and restoring the soil health in the WRCS.

Keywords: CO_2 equivalent; Soil carbon fraction; Ecosystem services; Recycled industrial wastes; Wheat-rice farming

Ram Swaroop Meena, Gourisankar Pradhan. (Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, UP, 221 005, India). Industrial garbage-derived biocompost enhances soil organic carbon fractions, CO_2 biosequestration, potential carbon credits and sustainability index in a rice-wheat ecosystem. Environmental Research, Volume 235 (2023): 116525

The objectives of this experiment were i) to study on the garbage composting to improve the soil organic carbon (SOC) pools (active and passive), ii) work out the carbon (C) budgeting, and iii) cut off C footprints (CFs) in the rice (Oryza sativa L.)-wheat (Triticum aestivum L.) farming to achieve the long-term sustainability. The main plots show four fertilizer levels (F0 = control, F1 = 112.5:45:45 kg nitrogen; phosphorus; potassium (NPK) ha−1, F2 = 150:60:60 kg NPK ha−1 and F3 = 150:60:60 kg NPK ha−1+ 5 kg iron (Fe) + 5 kg zinc (Zn) were applied, while in sub plots with the combination of three industrial garbage (I1 = carpet garbage; I2 = pressmud; I3 = bagasse) and three microbial culture (M1 = Pleurotus sajor-caju, M2 = Azotobacter chroococcum; M3 = Trichoderma viride) made into nine treatment combinations were applied. Based on the interaction, treatment F3 × I1+M3 resulted in a maximum of 25.1 and 22.4 Mg ha−1 total CO2 biosequestration by rice and wheat, respectively. However, it was cut off CFs by 29.9 and 22.2% more than F1 × I3+M1. Based on the soil C fractionation study, in the main plot treatment, F3 was active very labile C (VLC) and moderately labile C (MLC) and passive less labile C (LLC) and recalcitrant C (RC) SOC fractions contributed by 68.3 and 30.0%, respectively, of total SOC. However, in the sub plot, treatment I1+M3 found 68.2% and 29.8% active and passive SOC fractions, respectively, of total SOC. Regarding the soil microbial biomass C (SMBC) study, F3 had 37.7% higher than F0. However, in the sub plot, I1+M3 was seen to be 21.5% greater than I2+M1. Furthermore, wheat and rice had higher 1002 and 897 US$ ha−1 potential C credit in F3 × I1+M3, respectively. SOC fractions were perfectly positively correlated with SMBC. A positive (+) correlation was observed among grain yield (wheat and rice) and SOC pools in soil. However, a negative correlation was found between the C sustainability index (CSI) and greenhouse gas intensity (GHGI). The variability in wheat and rice grain yield was 46 and 74%, respectively, contributed by the SOC pools. Therefore, this study hypothesised that applying inorganic nutrients and industrial garbage converted into biocompost cut off C emissions and reduced the demand for chemical fertilizers, opening garbage disposal, and simultaneously enhancing the SOC pools.

Keywords: Active and passive C pools; Biocompost; CO2 biosequestration; C footprints; Potential C credits; Wheat-rice

Biopesticide

Paula Ortega, Ramón Salcedo, Elena Sánchez, Emilio Gil. (Universitat Politècnica de Catalunya, Department of Agro-Food Engineering and Biotechnology, Esteve Terradas, 8, 08860 Castelldefels, Spain). Biopesticides as alternatives to reduce the use of copper in

Spanish and Portuguese viticulture: Main trends in adoption. European Journal of Agronomy, Volume 151 (2023): 126996

The traditional use of copper as a fungicide in vineyards has raised concerns among authorities as it increases environmental pollution. As a result, new regulations have been enacted to reduce the use of plant protection products while encouraging the use of biological pesticides, which are less harmful to the environment. In this study, we surveyed two of the most relevant countries in terms of vine cultivation: Spain and Portugal. The objective of this study was to analyse the factors influencing the use of copper-based fungicides and their biological alternatives to provide a framework for state-of-the-art downy mildew control. This has led to some forward-thinking on the applicability of EU objectives. A probabilistic LogiT model was used to observe the field and exploitation variables that influenced winegrowers' use of biopesticides. Given its great reliance on copper, it can be concluded that copper is still a necessary product for viticulture. Moreover, because the use of synthetic products is prohibited in organic vineyards, more copper treatments are carried out. Although the intention to use biopesticides exists, this did not result in actual use. The most influential factor in the probability of biopesticide use is knowledge of the legislation; however, it is also important to have watercourses near the field and to have the necessary technology. These results are relevant for formulating recommendations to ensure that all information reaches small farmers, as this would be key to more sustainable agriculture in Europe.

Keywords: Copper; Crop protection; Fungicides; Organic production; Vineyards

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Lasiodiplodia species causing mango Stem-end rot disease (SER) are mainly controlled using synthetic products, which can harm humans and environmental health. Therefore, developing an eco-friendly control method, such as using plant extract products, is imperative. In this study, we evaluated the inhibitory effect of 3 biopesticides based on essential oils (ASTOUN 50 EC, FERCA 50 EC, and NECO 50 EC) at 300, 500, 700, 1000 ppm and Moringa oleifera leaves extracts (Methanolic and aqueous) at 5, 10, 15 and 20 g/250 ml on mycelial growth of Lasiodiplodia theobromae in vitro. Subsequently, 135 fruits (cv. Kent) per treatment were inoculated (1 × 105 spores/ml) and treated with each biopesticide (700, 1000 and 2000 ppm) and M. oleifera leaves extracts (15 and 20 g/250 ml) in vivo to evaluate their efficacy on mango SER development. The results showed that the biopesticides ASTOUN (Cymbopogon citratus) and NECO (Occimmun gratissimun) completely inhibited the mycelial growth of L. theobromae at 700 and 1000 ppm. Similarly, M. oleifera methanolic extract has the highest inhibitory rate

(65.45 %) compared to aqueous extract (42.44%). Moreover, 1000 and 2000 ppm of biofungicides and 15 and 20 g/250 ml of M. oleifera methanolic extract significantly reduced mango SER development compared to the control. This study provides evidence that these plant extracts are effective alternatives to mango SER management that are consistent with sustainable agriculture principles, promote ecological balance, and reduce the environmental impact of conventional agriculture.

Keywords: Biocontrol; Lasiodiplodia spp; Mango; Environment; Human; Health

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A collection of by-products was surveyed for novel biostimulant and biopesticide activity by establishing a screening platform (Bio2Bio) that integrated a broad spectrum of *in vitro* and *in* planta bioassays. Here, we report plant growth-promoting and biopesticide activities obtained from four solvent extracts of maize distillers' dried grains with solubles (DDGS), a bioethanol fermentation by-product. The hexane extract stimulated Arabidopsis primary root growth, whereas the ethanol extract enhanced tomato shoot growth and fresh biomass. The water extract showed fungicide, acaricide, nematicide, and protective activities, specifically conferring disease tolerance by inducing the plant immune response. We demonstrate significant biopesticide effects of DDGS water extract against the fungus Magnaporthe oryzae (32 % *in vitro* efficacy), oomycete Phytophthora infestans (73 % *in planta* efficacy), and spider mite Tetranychus urticae (60 % *in vitro* efficacy), as well as plant-induced resistance against the fungal pathogen Botrytis cinerea (30 % *in planta* efficacy) and root-knot nematode *Meloidogyne graminicola* (91 % *in vitro* and 50 % *in planta* efficacy). The broad range of bioactivities suggests that DDGS is a complex mixture composed of a wide variety of plant metabolites. DDGS represents a valuable source for discovering bioactive ingredients with potential use as biostimulants and/or biopesticides.

PAN Fan [1 2] *, GAO Li-jie [2] *, ZHU Kai-hui [1], DU Gui-lin [3], ZHU Meng-meng [4], ZHAO Li [5], GAO Yu-lin [1], TU Xiong-bing [1], ZHANG Ze-hua [1]. ([1]State Key Laboratory for Biology of Plant Diseases and Insect Pests, Institute of Plant Protection, Chinese Academy of Agricultural Sciences, Beijing 100193, P.R.China, [2]College of Animal Science and Technology, Hebei Agricultural University, Baoding 071001, P.R.China, [3]National Animal and Husbandry Service, Beijing 100125, P.R.China, [4]Institute of Plant Protection, Ningxia Academy of Agricultural and Forestry Sciences, Yinchuan 750002, P.R.China, [5]College of Agriculture, Xinjiang Agricultural University, Urumqi 830052, P.R.China). **Regional selection of insecticides and fungal biopesticides to control aphids and thrips and improve the forage quality of alfalfa crops. Journal of Integrative Agriculture, Volume 22, Issue 1 (2023): 185-194**

The efficacies of biological and conventional chemical insecticides against two major insect pests of alfalfa (aphids and thrips) were compared in three sites across China's alfalfa belt. In addition, the persistence of the residues of chemical insecticides in alfalfa and their influence on the quality of alfalfa hay were examined. Efficacy varied among the different biological and chemical insecticides. The chemical insecticides were significantly more effective than biopesticides in a short time-frame. The efficacy period of biopesticides was significantly longer than that of chemical insecticides, and the corrected mortality rate of aphids in all regions was above 50% at 14 days after application. The analysis of pesticide residues showed that the residual doses of all the pesticides were within the allowed ranges after the safe period. The acid detergent fiber and neutral detergent fiber contents in alfalfa hay were higher and the protein content was lower in chemical insecticide treatments than in biopesticide treatments in Hebei. The relative feeding value of alfalfa hay treated with *Metarhizium anisopliae* IPP330189 was the highest among the treatments. Compared with chemical insecticides, the yield of alfalfa hay was higher in the biopesticides treatments. Biopesticides show a stronger control effect on insect populations and also a better improvement in the quality of alfalfa hay than chemical insecticides. This study provides a basis for exploring and developing a comprehensive control regime for alfalfa insect pests in the different alfalfa-growing regions in China, and for reducing chemical insecticide usage and improving forage quality.

Keywords: insect pest control; pollution free control; pesticide residue; aphids; thrips

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Biopesticides are natural compounds considered more safe and sustainable for the environment. However, it is also important to evaluate the potential risk in non-target organisms. Pyrethrum extract (PE) is a biopesticide, widely used for agriculture, veterinary, and aquaculture. This work aimed to evaluate acute (0.6 – 40.0 µg/L; 96 h; $E(L)C_{50}$ toxicity) and sub-chronic (0.7 – 1.1 µg/L; 10 d; life-history parameters) effects of PE on Daphnia magna. Moreover, a biomarkers approach using antioxidant and biotransformation capacity, lipid peroxidation (LPO), neurotoxicity, and energy reserves content were evaluated. Acute effects (mortality, changes in swimming behavior, oxidative stress, lipid peroxidation, neurotoxicity) were recorded

with the increase in PE concentration. Sub-chronic assay showed an increase in energy reserves content, antioxidant parameters, and LPO demonstrating that PE unbalances oxidative metabolism. This study can conclude that PE potentiates toxic effects in *D. magna* and demonstrates the vulnerability of a non-target organism to PE that is considered environmentally safe.

Bighneswar Baliyarsingh, Chandan Kumar Pradhan. (Department of Biotechnology, Odisha University of Technology and Research, Ghatikia, Bhubaneswar, 751029, Odisha, India). Prospects of plant-derived metallic nanopesticides against storage pests - A review. Journal of Agriculture and Food Research, Volume 14 (2023): 100687

The desire to increase agricultural productivity and to alleviate food losses caused by insects during post-harvest storage periods has augmented the rampant use of unsafe chemo-synthetic pesticides. The elevated health risks on human or domestic animals and environmental pollution by chemo-pesticides have shifted the focus of getting eco-friendly pesticides from biological entities. Research on the nanotechnological application in agriculture has become popular and promising. The diversity among plant species as well as the possession of different insect-specific bioactive compounds makes them the favoured choice for exploring active ingredients, and the application of nanoscience has facilitated the development of effective nano-biopesticides. Varieties of phytochemical groups act as reducing- and stabilizing agents during the biosynthesis of metallic nanoparticles that would be operated as nanobiopesticides. Moreover, green synthesis of metallic nanoparticles or nano-conjugates, especially silver nanoparticles have been experimentally proven successful in controlling insects of stored food products. This review compiles phyto-derived metallic nanoparticles' potential and effectiveness against storage insects, and the analysis will augment research in designing and promoting the development of eco-friendly agrochemicals.

Federico Cappa, Livia De Fazi, David Baracchi, Rita Cervo. (Dipartimento di Biologia, Università degli Studi di Firenze, Via Madonna del Piano, 6, 50019 Sesto Fiorentino, Italy). Adverse effects of the fungal biopesticide Beauveria bassiana on a predatory social wasp. Science of The Total Environment, Volume 908 (2023): 168202

Biopesticides are considered eco-friendly alternatives to synthetic agrochemicals. However, their impact on non-target organisms is still poorly understood. Social wasps, in particular, are a largely neglected group when it comes to risk assessment of plant protection products, despite the relevant ecological and economic services provided by these insects. In the present study, we evaluated the impact of a common biopesticide, the entomopathogenic fungus Beauveria bassiana, on the paper wasp Polistes dominula. We adopted a holistic approach in ecotoxicology by focusing not only on the detrimental effects on isolated individuals, but also on the whole colony. Both adult wasps belonging to different castes and immature larvae were topically exposed to a field-realistic concentration of fungal spores from the commercial strain of B. bassiana ATCC 74040 to assess the impact of the biopesticide on their survival, behavior and physiology. Our results showed that the fungus causes a number of adverse effects on P. dominula, that include increased mortality, altered locomotion and feeding rate, selective ejection of exposed larvae from nests, reduced oviposition rate and ovary development in foundresses, and colony failure. Our findings provide new insights on the often-neglected sublethal effects of pollutants that can jeopardize not only individual beneficial insects, but also the delicate social balance of their colonies and their valuable ecosystem services, highlighting that the natural origin of plant-protection products does not always guarantee environmental safety.

Keywords: Ecotoxicology; Biological control; Entomopathogenic fungus; Sublethal effects; Polistes; Social wasps

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With a growing global population, the demand for food, clothing and shelter became crucial for sustaining life. Moreover, the COVID-19 pandemic/endemic, along with the threat of other endemics, posed significant challenges in ensuring the delivery of nutritionally rich food. To address this, the World Health Organization (WHO) recommended the ban of some highly toxic chemical pesticides. Excessive consumption and exposure to pesticides possibly contributed to a decline in the human immunity levels making our fight against the pandemics more difficult and challenging. During the lockdown COVID-19 crisis, we conducted a survey to gather insights from farm landers (FLs), garden lovers (GLs), domestic front users (DFUs) predominantly from India, but also from other regions worldwide. The survey aimed at better understanding the usage of pesticides, both chemicals (CPs), bio-pesticides (BPs) or both, and their global utilization. A statistical survey with seven rudimentary sections was designed to receive the inputs (elementary inputs, awareness and perception, pesticide utility, health, ecology, and alternatives for safer trials) with fairness and care. The data was statistically analyzed within each group of population, revealing significant variations within the groups. Our study indicated that FLs (44.7 %) predominantly used BPs, GLs (18.8 %) relied on CPs, while DFUs (100.0 %) used a combination of both without any specific intention. Correlation analysis, given by R (correlation coefficient) and p (probability of obtaining an equal or more extreme effect than the found considering the null hypothesis as true) values revealed the existence of a positive and significant relationship between the selected variables, such as level of education (LOE) and gender, with the adoption of new alternatives (2loglikelihood = 64.743, with $\chi 2 = 128.4$, degrees of freedom (df) = 24, p<*0.05, **0.01, and *** 0.001) through multinomial regression analysis, indicating the fitness of the model. Likewise, our study primarily focused on exploring the insights for the development of nano-biopesticides, as improved alternatives to the existing solutions.

Keywords: Practice; Awareness; Perception; Health; Eco-system; Alternative; Recommendations

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Biopesticides from Brassicaceae plants can reduce the impact of synthetic pesticides by providing an environmentally sustainable yet economically sound pest control option. Meals of Brassicaceae oilseed crops are by-products of oil extraction, that are both affordable and easily accessible. Pesticidal activity of Brassicaceae oilseed meals is attributed to glucosinolates that upon hydrolysis by myrosinase produce pesticidal isothiocyanates. Here we present kinetics analysis of extracts from Sinapis alba and Brassica juncea containing active myrosinase isoenzymes toward the endogenous and exogenous glucosinolates with the goal of improving the biopesticide formulation. Based on Michaelis–Menten kinetics, S. alba myrosinase had 10–20 times higher activity toward endogenous sinalbin and exogeneous sinigrin and glucolimnanthin glucosinolates. B. juncea myrosinase exhibited Michaelis–Menten kinetics with endogenous sinigrin and exogeneous glucolimnanthin but not with exogeneous sinalbin. These findings indicate the preferential activity of isoenzymes toward glucosinolates and possibility of using an exogenous myrosinase for improving the release rate of pesticidal isothiocyanates in Brassicaceae biopesticides.

Keywords: Biopesticides; Mustard seed meal; Myrosinase kinetics; Glucosinolates; Mustard seeds; Brassicaceae plants

Jiabei Xie[a], Wisnu Adi Wicaksono[b], Zhaoyang Lv[a], Gabriele Berg[bcd], Tomislav Cernava[be], Beibei Ge[a] (a. State Key Laboratory of Biology of Plant Diseases and Insect Pests, Institute of Plant Protection, Chinese Academy of Agricultural Sciences, Yuanmingyuan West Road, No. 2, Haidian District, Beijing 100193, China, b. Institute of Environmental Biotechnology, Graz University of Technology, Petersgasse 10, Graz 8010, Austria, c. Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB), Max-Eyth Allee 100, 14469 Potsdam, Germany, d. Institute for Biochemistry and Biology, University of Potsdam, 14476 Potsdam OT Golm, Germany, e. School of Biological Sciences, University of Southampton, SO17 1BJ Southampton, United Kingdom). Rhizosphere bacteria show a stronger response to antibiotic-based biopesticide than to conventional pesticides. Journal of Hazardous Materials, Volume 458 (2023): 132035

The plant microbiota can substantially contribute to various functions related to host health, fitness, and productivity. Therefore, maintaining the integrity of the microbiota is beginning to be seen as a crucial factor in modern agriculture. Here, we evaluated the effects of two chemical pesticides (azoxystrobin and carbendazim) and an antibiotic-based biopesticide (wuyiencin) on the rhizosphere microbiome of tomato plants. It was found that all treatments resulted in changes in the bacterial community structure to varying degrees. The most pronounced changes were observed with the biopesticide, which resulted in an enrichment of Streptomyces in the microbiome. In contrast, the relative abundance of Actinobacteria decreased in samples that were treated with low and high dosages of carbendazim. Clostridia were enriched after the applications of azoxystrobin and wuyiencin. When functioning of the microbiome was assessed, it was shown that genes encoding multidrug efflux pumps and ABC transporters related to nutrient uptake were enriched. This enrichment is likely to overcome potentially negative effects linked to the exposure to the employed substances. The study provides new insights into the potential of different pesticides to modulate native plant microbiomes, and thus highlights the importance to include such evaluations when new active agents are developed.

Keywords: Agrochemicals; Wuyiencin; Off-Target Effects; Plant Microbiome; Bacterial Communities

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Protection, Nanjing Agricultural University, Nanjing 210095, P.R. China). Point mutations of Dicer2 conferred Fusarium asiaticum resistance to RNAi-related biopesticide. Journal of Integrative Agriculture (2023): https://doi.org/10.1016/j.jia.2023.10.024

The use of RNA interference (RNAi) technology to control pests is explored by researchers globally. Even though RNA is a new class of pest control compound unlike conventional chemical pesticides, the evolution of pest resistance needs to be considered. Here, we first investigate RNAi-based biopesticide resistance of Fusarium asiaticum, which is responsible for devastating diseases of plants, for example, Fusarium head blight. Five resistant strains were isolated from 500 strains that treated with UV-mutagenesis. The mutation common to all of the five resistant mutants occurred in the gene encoding Dicer2 (point mutations at codon 1005 and 1007), which were under strong purifying selection pressure. To confirm whether the mutations in Dicer2 confer resistance to RNAi, we exchanged the Dicer2 locus between the sensitive strain and the resistant strain by homologous double exchange. The transformed mutants, Dicer2R1005D and Dicer2E1007H, exhibited resistance to dsRNA in vitro. Further study showed that mutations of R1005D and E1007H affected the intramolecular interactions of Dicer2, resulting in the dysfunction of RNase III domain of Dicer2. The amount of sRNAs produced by Dicer2R1005D and Dicer2E1007H was extremely reduced along with variation of sRNA length. Together, these findings revealed a new potential mechanism of RNAi resistance and provided insight into RNAi-related biopesticide deployment for fungal control.

Keywords: RNA interference; dsRNA; Dicer2; point mutation; resistance; Fusarium asiaticum

Biodegradation

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Polybutylene adipate-*co*-terephthalate (PBAT) is a flexible and biodegradable material that finds applications in mulching film and the food packaging industry. In this study, we aimed to address the global plastic waste problem by developing an improved biodegradation system for PBAT. Our focus was on utilizing the biodegradation capabilities of *Pseudozyma jejuensis*, a microorganism known for its ability to decompose Polycaprolactam (PCL). Through bio-stimulation, we aimed to enhance the growth mechanism of *P. jejuensis* and optimize PBAT biodegradation. Our results demonstrated significant structural changes in the PBAT film, as revealed by FT-IR analysis. Moreover, FE-SEM imaging exhibited evident surface erosion and pitting, indicating physical alterations due to biodegradation. These findings provide strong evidence for the efficiency of our developed biodegradation system. To fully harness the potential of this system and enable its practical implementation, further research is warranted to

optimize and scale up the process. Our work contributes to the ongoing efforts to combat the global plastic waste crisis, offering a valuable solution for the efficient biodegradation of PBAT.

Oana Adriana Cuzman [a], Loredana Luvidi [a], Claudia Colantonio [a], Aida Raio [b], Stefano Taiti [c]. ([a]Institute of Heritage Science (ISPC – CNR, Florence Unit, Rome Unit), Italy, [b]Institute for Sustainable Plant Protection (IPSP – CNR, Florence), Italy, [c]Research Institute on Terrestrial Ecosystems (IRET– CNR, Florence), Italy). Biodiversity and conservation correlation in the case of a Roman fresco located in a semi-confined environment. International Biodeterioration & Biodegradation, Volume 181 (2023): 105605

The subterranean heritage includes both natural and built sites with a strong cultural and historical fingerprint, some of each being enriched with painted surfaces. These semi-confined environments shelter specific and fragile biodiversity. This paper is focused on the case of a Roman painting (2nd-3rd century AD) located in an underground archaeological site in Marino Laziale, near Rome, which was opened to the public for the first time in 2021. The painted Mithraic scene is in a good state of conservation. The methodological approach included on site and laboratory investigations aimed to screen the main biological components associated to this hypogeum monument. The observed biodiversity included heterotrophic and chemolithotrophic microorganisms, and a mesofauna composed of eutroglophile and subtroglophile species, characteristic for many subterranean environments. The ecological mechanisms and the conservation state of the work of art were analyzed for planning the best fruition practices. The aesthetic change, the possible mechanical damages induced by various organisms, and the presence of significant amounts of organic matter, represent the main risks for painting conservation. These aspects, beside the new possible risks associated with the presence of visitors, are under a constant and ongoing conservation surveillance program.

Keywords: Hypogeum environment; Biodeteriogens; Bacteria; Fungi; Conservation; Monitoring; Mesofauna; Microfauna

Denilso Ibiapino Fontes [a], Taiana Sousa Bezerra [a], Endril Pablo Brasil de Freitas [a], Marilene Nunes de Oliveira [a], Sebastião da Cruz Silva [a], Simone Yasue Simote Silva [a], Ulisses Brigatto Albino [a], Darlisson de Alexandria Santos [a b]. ([a]Programa de Pós-Graduação em Química, Instituto de Ciências Exatas, Universidade Federal do Sul e Sudeste do Pará, Folha 17, Quadra 04, Lote Especial, s/n, Nova Marabá, 68505-080, Marabá, PA, Brazil, [b]Laboratório de Síntese Orgânica e Aplicações Biotecnológicas, Departamento de Química Fundamental, Universidade Federal de Pernambuco, Avenida Jornalista Aníbal Fernandes, Cidade Universitária, 50740-560, Recife, PE, Brazil). International Biodeterioration & Biodegradation, Volume 182 (2023); 105631

Two Amazonian fungi strains — *Aspergillus* sp. A1C2-06 and *Talaromyces verruculosus* A1C2-05 — were studied about their potential as cellulase producers and theis applications in the saccharification of sugarcane bagasse and babassu lignocellulosic biomass. For the cellulase production was studied the influence of cultivation parameters during the solid-state fermentation. The best initial pH were 3,0 and 7,0 for *T. verruculosus* and *Aspergillus* sp., respectively, and the optimum temperature was 35 °C for both strains. The ideal Mandel' solution volume was 7,5 ml and 10,0 ml for *T. verruculosus* and *Aspergillus* sp., respectively. The optimal conditions during the hydrolysis of filter paper cellulose were determined, being 2,8 the optimal pH for both cellulases and the optimal temperature were 50 °C and 60 °C for *Aspergillus* sp and *T. verruculosus*, respectively. The cellulases from both *Aspergillus* sp and *T. verruculosus* were capable of hydrolyzing the lignocellulosic biomasses but in different

degree of saccharification. The saccharification degree for both pretreated biomasses reached 80% when cellulases from *T. verruculosus* were applied for 72h, while the untreated biomasses reached only 60% for babassu and 50% for sugarcane bagasse, indicating that the removal of lignin has an important role in the process of biomass saccharification.

Songsong Chen [a], Limin Ma [b], Guodong Yao [b], Yuncai Wang [a]. ([a]College of Architecture and Urban Planning, Tongji University, 1239, Siping Road, Shanghai, 200092, PR China, [b]College of Environmental Science and Engineering, Tongji University, 1239, Siping Road, Shanghai, 200092, PR China). Efficient atrazine removal in bioaugmentation constructed wetland: Insight from stable isotope fractionation analysis. International Biodeterioration & Biodegradation, Volume 185(2023): 105691

Constructed wetlands (CW) provides a sustainable approach to remove pesticides from agricultural or urban runoff, while the low efficiency of the herbicide atrazine remains a challenge. Focused on improving atrazine removal in CW, a bioaugmentation strategy was implemented using the mixed culture of atrazine-degrading bacteria. The results shown a significant increase in atrazine removal from 26.2 ± 6.9% to 60.9 ± 8.7–90.6 ± 4.1% during the bioaugmentation phases. To investigate in-situ degradation processes of atrazine, compound-specific stable isotope analysis (CSIA) was conducted. The carbon and nitrogen isotope fractionation pattern revealed atrazine was primarily degraded via a hydrolysis pathway mediated by microorganisms. The biodegradation extent of atrazine calculated from $\delta^{13}C$ signatures suggested that 90% of atrazine was removed via the hydrolysis pathway, with only a small portion being removed abiotically. This was additionally supported by an increase in microbial diversity and the abundance of specific bacteria (such as Rhizobium sp. and *Pseudomonas* sp.) capable of degrading atrazine. Altogether, this study demonstrated the effectiveness of atrazine-degrading mixed culture and its feasibility on bioaugmentation atrazine removal in CW. This work highlights the potential of bioaugmentation in sustainable pesticide removal approaches and CSIA can contribute to an understanding of in-situ pesticide transformation processes in wetland systems.

María Cecilia Della Vedova [a b], José Oscar Bonilla [a b], María Daniela Paez [c], Eduardo Alberto Callegari [c], Raúl Andrés Gil [a b], Liliana Beatriz Villegas [a b]. ([a]Instituto de Química de San Luis (INQUISAL), CONICET, FQByF, UNSL, San Luis, Argentina, [b]Facultad de Química, Bioquímica y Farmacia, Universidad Nacional de San Luis, San Luis, Argentina, [c]Division of Basic Biomedical Sciences Sanford School of Medicine, University of South Dakota, Vermillion, SD, USA). *Saccharomyces cerevisiae* as a biological model to study microbial responses to copper and chromium stress. International Biodeterioration & Biodegradation, Volume 184 (2023): 105648

To understand the aspects of how organisms cope with copper and chromium stress, *Saccharomyces cerevisiae* was used as a model. To achieve this purpose, Scanning Electron Microscopy coupled to X-Ray Dispersive Energy Spectrometry (SEM-EDS) was applied to analyze the microelemental composition and the surface mapping of microbial biomass, in the presence and absence of 30 μg mL^{-1} Cu(II) and Cr(VI) after 72 h of incubation. Additionally, a shotgun proteomic analysis was carried out using nanoUHPLC-ESI-MS/MS on cytosolic proteins and the cell-free supernatants to analyze the differential protein expression at the intracellular and extracellular level in the presence of the metals. Bioinformatic analysis was performed using the Swiss-Prot database specific for *S. cerevisiae* and MASCOT v2.7.1. The

comparative analysis of protein expression of the samples was performed using ProteoIQ v2.8. The microorganism responds by adjusting intracellular and extracellular protein expression, and also by adjusting microelemental composition variation. The results show that cells exposed to Cu(II) obtained the advantage of enduring unfavorable conditions, while cells exposed to Cr(VI) decreased the expression of proteins important for repair and cell function.

Federica De Marines [a], Ilenia Cruciata [b], Gaetano Di Bella [c], Daniele Di Trapani [a], Maria Gabriella Giustra [c], Laura Scirè Calabrisotto [b], Pietro Greco Lucchina [a], Paola Quatrini [b], Gaspare Viviani [a]. ([a]Department of Engineering (DI), University of Palermo, Viale delle Scienze, bldg. 8, 90128, Palermo, Italy, [b]Department of Biological, Chemical and Pharmaceutical Sciences and Technologies (STEBICEF), University of Palermo, Viale delle Scienze, bldg. 16, 90128, Palermo, Italy, [c]Faculty of Engineering and Architecture, University of Enna "Kore", Cittadella Universitaria, 94100, Enna, Italy). Degradation of 1,2-dichloroethane in real polluted groundwater by using enriched bacterial consortia in aerobic and anaerobic laboratory-scale conditions. International Biodeterioration & Biodegradation, Volume 183 (2023): 105644

The aim of this work was to gain insights about the feasibility of chlorinated solvents removal through biostimulated and bioaugmented biological processes in laboratory-scale permeable reactive barriers (PRBs) under anaerobic and aerobic conditions. The experimental plant consisted of two Plexiglas cylindrical columns filled with silica sand and fed with real groundwater contaminated by chlorinated solvents (mainly 1,2-dichloroethane, 1,2-DCA, at a concentration of 20 mg l^{-1}). Column A simulated a PRB containing poly-β-hydroxybutyrate (PHB) powder as electron donor and worked under anaerobic conditions; in Column B an inlet air flow rate ensured aerobic conditions. Both columns were inoculated with dechlorinating bacterial consortia obtained by enrichment cultures from the same contaminated groundwater. Results from Column A showed that PHB can be fermented and used as a slow-releasing carbon source for sustaining reductive dechlorination, as revealed by acetate production up to 267 mg l^{-1} and 100% 1,2-DCA removal. The microbial community detected in Column A at the end of the experimental period was mainly enriched in sulfate reducing bacteria that could act as both fermenting and dechlorinating agents. Column B showed a slight lower 1,2-DCA removal efficiency (98%) likely related to the establishment of aerobic (co)metabolic processes.

Yewon Jang[a], Minseo Kim[a], Yeji Kim[a], Jaeyoung Yu[a], Sung-Kon Kim[a], Jeehoon Han[b], Yang-Hoon Kim[c], Jiho Min[a]. (a. School of Semiconductor and Chemical Engineering, Jeonbuk National University, 567 Baekje-daero, deokjin-gu, Jeonju-si, Jeollabuk-do, 54896, Republic of Korea, b. Department of Chemical Engineering, Pohang University of Science and Technology, Pohang, 37673, Republic of Korea, c. Department of Microbiology, Chungbuk National University, Chungdae-Ro, Seowon-Gu, Cheongju, 28644, Republic of Korea). Enhancing biodegradation of PBAT through bio-stimulation using Pseudozyma jejuensis for effective plastic waste reduction. Chemosphere, Volume 340 (2023): 139867

Polybutylene adipate-co-terephthalate (PBAT) is a flexible and biodegradable material that finds applications in mulching film and the food packaging industry. In this study, we aimed to address the global plastic waste problem by developing an improved biodegradation system for PBAT. Our focus was on utilizing the biodegradation capabilities of Pseudozyma jejuensis, a microorganism known for its ability to decompose Polycaprolactam (PCL). Through bio-stimulation, we aimed to enhance the growth mechanism of P. jejuensis and optimize PBAT biodegradation. Our results demonstrated significant structural changes in the PBAT film, as

revealed by FT-IR analysis. Moreover, FE-SEM imaging exhibited evident surface erosion and pitting, indicating physical alterations due to biodegradation. These findings provide strong evidence for the efficiency of our developed biodegradation system. To fully harness the potential of this system and enable its practical implementation, further research is warranted to optimize and scale up the process. Our work contributes to the ongoing efforts to combat the global plastic waste crisis, offering a valuable solution for the efficient biodegradation of PBAT.

Keywords: Polybutylene adipate-co-terephthalate; Pseudozyma. jejuensis; Biodegradation; Plastic waste; Bio-stimulation

Tian Xia, Yongge Sun. (Organic Geochemistry Unit, School of Earth Sciences, Zhejiang University, Hangzhou 310027, China). Biodegradation effects on the distribution of aromatic carotenoids in crude oils. Organic Geochemistry, Volume 186 (2023): 104694

In this study, we use a previously confirmed group of progressively biodegraded oils to investigate the biodegradation effects on the distribution of aromatic carotenoids. The results clearly show that compared to the saturated C40 β-carotane, all aromatic carotenoids detected in crude oils were affected by biodegradation. Significant changes mainly occur after moderate biodegradation and trace or undetectable levels of aromatic carotenoids and carotane would be expected in severely degraded oils. These results suggest that caution must be taken during evaluations on the degree of anoxia/euxinia in the depositional system by concentrations of aromatic carotenoids and/or related ratios when potentially biodegraded crude oils and outcrop rocks are used.

Keywords: Crude oil; Aromatic carotenoids; Biodegradation; Photic zone euxinia

Patricia Wolf, Martin Reimer, Maximilian Maier, Cordt Zollfrank. (Technical University of Munich, Chair for Biogenic Polymers, TUM Campus Straubing for Biotechnology and Sustainability, Schulgasse 16, 94315 Straubing, Germany). Biodegradation of polysaccharides, polyesters and proteins in soil based on the determination of produced carbon dioxide. Polymer Degradation and Stability, Volume 217 (2023): 110538

The biodegradation of polymers can be determined by measuring the CO_2 evolution from the biodegradation medium, for example soil. In this work, the biological degradation of cellulose (powder and fibers), polylactic acid (PLA, powder and films), a combination of both and lupin protein isolate (LPI, films) was investigated. Therefore, a reliable method using a respirometric system needed to be developed. The soil to sample ratio, the system boundaries concerning the maximum CO_2 uptake and O_2 consumption in addition to the change in electrical conductivity of the KOH absorbant solution caused by CO_2 uptake were investigated. LPI-based films showed the highest biodegradation in %, followed by regenerated cellulose fibers (RC fibers). In case of PLA only the samples with powder morphology were biological degraded. The degradation of PLA films was highly increased to 68 % by addition of microfibrillated cellulose (MFC). The samples were analyzed before and after biodegradation using scanning electron microscopy (SEM) and gel permeation chromatography (SEC). The developed method was successful to validate the degree of biodegradation for a large variety of biogenic polymers and can be generally applied.

Keywords: Biodegradation; Soil; Respirometry; Microfibrillated cellulose; Lupin protein; PLA

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Environmental and Geographical Science, Shanghai Normal University, Shanghai 200234, PR China, b. Zhejiang Provincial Key Laboratory of Water Science and Technology, Department of Environmental Technology and Ecology, Yangtze Delta Region Institute of Tsinghua University, Zhejiang, Jiaxing 314006, PR China, c. Biodesign Swette Center for Environmental Biotechnology, Arizona State University, Tempe, AZ 85287-5701, USA). The roles of Methylobacterium organophilum and Sphingomonas melonis for accelerating N-methyl pyrrolidone (NMP) biodegradation. Journal of Water Process Engineering, Volume 56 (2023): 104327

Although N-methyl pyrrolidone (NMP) is biodegradable, normal activated sludge exhibits poor NMP biodegradation unless it is acclimated with NMP for an extended time. In this work, glucose-acclimated biomass (GAB) was acclimated with NMP for over two months to obtain NMP-acclimated biomass (NAB). NAB was superior to GAB for NMP biodegradation, and this correlated to higher abundances of the genera Mycobacterium, Amaricoccus, and Thauera in NAB. However, when GAB was bioaugmented with Methylobacterium organophilum or Sphingomonas melonis, which were isolated from NAB based on their growth on NAB, the bioaugmented GAB immediately showed rapid biodegradation of NMP. M. organophilum was superior to S. melonis for accelerating NMP biodegradation, and the acceleration of NMP biodegradation was proportional to the mass of M. organophilum or S. melonis added. A key finding was that the limiting step for NMP mineralization was biodegradation of monomethylamine, an NMP-biodegradation intermediate that also is inhibitory. Bioaugmenting M. organophilum or S. melonis accelerated NMP biodegradation by enhancing monomethylamine removal, with M. organophilum being superior to S. melonis. The documented rapid impact of bioaugmentation can make it especially valuable in response to an input of a toxicant.

Keywords: N-methyl pyrrolidone; Biodegradation; Bioaugmentation; Methylobacterium organophilum; Sphingomonas melonis

Sangwoo Park[a], Jungkyu Kim[a], June-Ho Choi[b], Jong-Chan Kim[a], Jonghwa Kim[c], Youngmin Cho[a], Seungoh Jung[a], Hyo Won Kwak[ac], In-Gyu Choi[ac] (a. Department of Agriculture, Forestry, and Bioresources, College of Agriculture and Life Sciences, Seoul National University, Seoul 08826, Republic of Korea, b. Advanced Convergent Chemical Division, Center for Biobased Chemistry, Korea Research Institute of Chemical Technology, Ulsan 44429, Republic of Korea, c. Research Institute of Agriculture and Life Sciences, College of Agriculture and Life Sciences, Seoul National University, Seoul 08826, Republic of Korea). Biodegradation behavior of acetylated lignin added polylactic acid under thermophilic composting conditions. International Journal of Biological Macromolecules, Volume 253, Part 7 (2023): 127472

Acetylated lignin (AL) can improve compatibility with commercial plastic polymers compared to existing lignin and can be used as an effective additive for eco-friendly biocomposites. For this reason, AL can be effectively incorporated into polylactic acid (PLA)-based biocomposites, but its biodegradation properties have not been investigated. In this study, biodegradation experiments were performed under mesophilic and thermophilic conditions to determine the effect of AL addition on the biodegradation characteristics of PLA-based biocomposites. As a result, the PLA-based biocomposite showed a faster biodegradation rate in a thermophilic composting environment, which is higher than the glass transition temperature of PLA, compared to a mesophilic environment. 16S rDNA sequencing results showed that differences in microbial communities depending on mesophilic and thermophilic environments strongly

affected the biodegradation rate of lignin/PLA biocomposites. Importantly, the addition of AL can effectively delay the thermophilic biodegradation of PLA biocomposites. As a result of tracking the changes in physicochemical properties according to the biodegradation period in a thermophilic composting environment, the main biodegradation mechanism of AL/PLA biocomposite hydrolysis. It proceeded with cleavage of the PLA molecular chain, preferential biodegradation of the amorphous region, and additional biodegradation of the crystalline region. Above all, adding AL can be proposed as an effective additive because it can minimize the decline in the mechanical properties of PLA and delay the biodegradation rate more effectively compared to existing kraft lignin (KL).

Keywords: Kraft lignin; Acetylated lignin; Polylactic acid; Biocomposites; Biodegradation

Afsaneh Esmaeili Nasrabadi [a], Bahman Ramavandi [b], Ziaeddin Bonyadi [c]. ([a]Student Research Committee, Department of Environmental Health Engineering, School of Health, Mashhad University of Medical Sciences, Mashhad, Iran, [b]Department of Environmental Health Engineering, Faculty of Health, Bushehr University of Medical Sciences, Bushehr, Iran, [c]Department of Environmental Health Engineering, School of Health, Mashhad University of Medical Sciences, Mashhad, Iran). **Recent progress in biodegradation of microplastics by *Aspergillus* sp. in aquatic environments. Colloid and Interface Science Communications, Volume 57(2023): 100754**

The potential of *Aspergillus* sp. for plastic biodegradation is a promising approach for environmentally friendly waste management. Various research studies have been conducted to optimize conditions that enhance the biodegradation of plastics and to understand the genetic basis of *Aspergillus* species. By performing this investigation, we discussed the role of various species of *Aspergillus* sp. in the decomposition of plastic polymers. Most *Aspergillus* sp. grow within the pH range of 4 to 6. 37.5% of the studies showed that *Aspergillus* sp. grows optimally at 30 °C. Scanning electron microscopy (SEM) and Fourier transform infrared (FTIR) tests were used in 34.61% and 32.69% of the different studies, respectively. It has been observed that fungi can biodegrade polymers more effectively within a size range of 20–100 µm. Most studies (34.21%) have focused on the biodegradation of polymers within 21 to 30 days. The highest percentage of studies (44%) focused on the biodegradation of low-density polyethylene (LDPE) by various *Aspergillus* sp. The dominant *Aspergillus* sp., including *A. niger*, *A. flavus*, and *A. oryzae*, play a significant role in the biodegradation of microplastics. Enzymes such as laccase, esterase, peroxidase, lipase, and urease play crucial roles in the degradation of plastics. Laccase utilizes oxygen to generate reactive oxygen species, breaking polymer chains. Esterase cleaves polymers into fragments, while peroxidase generates radicals for polymer degradation. Lipases and urease also contribute to the degradation of specific plastic substrates. In general, it can be said that this fungal species has been successful in effectively degrading various polymers.

Keywords: Biodegradation; Fungi; *Aspergillus* species; Polymer; Microplastic

Soojin Kwon, Marielis C. Zambrano, Richard A. Venditti, Joel J. Pawlak. (Department of Forest Biomaterials, College of Natural Resources, North Carolina State University, 2820 Faucette Drive, Campus Box 8001, Raleigh, NC, 27695, USA). **Aerobic aquatic biodegradation of bio-based and biodegradable polymers: Kinetic modeling and key factors for biodegradability. International Biodeterioration & Biodegradation, Volume 185 (2023): 105671**

With the increasing concern about plastic waste, numerous efforts have been made to find substitutes for existing non-biodegradable synthetic polymers. Bio-based and/or purported petroleum-based biodegradable polymers are considered probable plastic replacement candidates. However, the durability of non-biodegradable plastic is a key feature of plastics. Thus, a balance must be achieved between biodegradation and environmental material stability. The objective of this study is to determine the impact of crystallinity, molecular chemistry, and hydrophilicity on the rate of aquatic biodegradation of biobased plastic materials. In the present study, twelve bio-based/purported biodegradable materials were investigated under aerobic aquatic biodegradation conditions for 56 days by tracking oxygen consumption. Crystallinity, hydrophobicity, chemistry, and chemical structure were varied to understand potential means for controlling the rate of biodegradation. The biodegradation kinetics were analyzed and discussed, relating to the characteristics of polymers. Polyvinyl alcohol (PVA), Chitosan, Rayon, Polyhydroxy-butyrate-co-valerate (PHBV), PHBH, and Polybutylene succinate (PBS) showed the biodegradation extents over 70% at 56 days. Cellulose acetates (CAs) and Polylactic acid (PLA) showed biodegradation extent lower than 20%. The chemistry of the polymer backbone chain, substituent structure, and degree of substitution were the dominant factors affecting biodegradation. The crystallinity of the polyesters had a negative correlation with the initial biodegradation rate and the ultimate biodegradation of polyesters, and the hydrophobicity of the polymers delayed the initiation of biodegradation. The aerobic aquatic biodegradation results related to the polymer characteristics are useful for product designers and environmental scientists to understand the fate of these polymeric materials in the environment.

Keywords: Bioplastics; Bio-based polymers; Aquatic biodegradation; Biodegradation kinetics; Crystallinity; Hydrophilicity

Biosensor

Mohammad Hossein Ayati[ab], Mostafa Araj-Khodaei[ac], Tannaz Haghgouei[d], Ali Ahmadalipour[ef], Ahmad Mobed[ade], Sarvin Sanaie[a] (a. Research Center for Integrative Medicine in Aging, Aging Research Institute, Tabriz University of Medical Sciences, Tabriz, Iran, b. Department of Persian Medicine, School of Persian Medicine, Tehran University of Medical Sciences, Tehran, Iran, c. Department of Persian Medicine, Faculty of Traditional Medicine, Tabriz University of Medical Sciences, Tabriz, Iran, d. Division of Pharmacology and Toxicology, Department of Basic Sciences, Faculty of Veterinary Medicine, University of Tabriz, Tabriz, Iran, e. Physical Medicine and Rehabilitation Research Center, Aging Research Institute, Tabriz University of Medical Sciences, Tabriz, Iran, f. Research Center of Psychiatry and Behavioral Sciences, Tabriz University of Medical Sciences, Tabriz, Iran). Biosensors: The nanomaterial-based method in detection of human gut microbiota. Materials Chemistry and Physics, Volume 307 (2023): 127854

The gut microbiota has emerged as an important aspect of clinical oncology. The role of microbiota in cancer goes beyond the risks and causes of cancer. Microbiotas are currently known to act at the local epithelial level of the intestine and alter the immune response of intestinal and extra-intestinal tumors. As probiotics are increasingly used in functional foods and pharmaceuticals, rapid and sensitive monitoring of probiotics is important for quality, purity, and safety management. Due to the weaknesses and limitations of routine microbiological techniques, developing advanced state-of-the-art methods is one of the main goals of researchers. One of the most critical and progressive areas is the nanomaterial-based method.

Biosensors are one of the most advanced methods based on nanomaterials. While biosensing technology for the human gut flora has the potential to transform the clinical diagnosis, point-of-care (POC) biosensors that directly detect microbial community disruptions are not currently available in clinical practice. This review study aimed to explore the potential of biosensors in identifying the human gut flora to achieve the best techniques for the first time.

Keywords: Nanomaterial; Nanotechnology; Gut microbiota; Biosensors

Lanmei Gao[a], Houbing Zheng[b], Yuanlong Hu[a], Yi Zhong[a], Linhai Jiang[a], Yuanzi Wu[a], Fen Yan[a], Da Huang[a], Jianhua Li[a], Fang Zhang[ac], Zhenyu Lin[c], Meishui Wang[b], Zuquan Weng[ab] (a. College of Biological Science and Engineering, Fuzhou University, Fuzhou, Fujian, China, b. Department of Plastic and Cosmetic Surgery, the First Affiliated Hospital of Fujian Medical University, Fuzhou, Fujian, China, c. Ministry of Education Key Laboratory for Analytical Science of Food Safety and Biology, Fuzhou University, Fuzhou, Fujian, China). Fluorescent biosensor based on MB-APT combined with Pt NPs for the detection of infectious bacteria in mouse and human wounds. Sensors and Actuators B: Chemical, Volume 393 (2023): 134318

Bacterial infection of wounds is one of great concern to patients, and rapid and correct detection of bacterial infection is crucial to ensure accurate diagnosis and early intervention. Based on the principle that glucose can only be consumed by live bacteria, a fluorescent biosensor was constructed to detect four kinds of common infectious bacteria (Acinetobacter baumannii, Escherichia coli, Pseudomonas aeruginosa and Staphylococcus aureus) in skin wounds, taking advantage of magnetic bead-aptamer for recognizing, sorting and enrichment, platinum nanoparticles for signal amplification. The linear detection range of AB, EC, PA and SA were 27– 8 × 106 CFU/mL, 10– 2.5 × 107 CFU/mL, 34– 2.5 × 107 CFU/mL and 10– 1.0 × 107 CFU/mL, respectively, and the limits of detection were 27 CFU/mL, 10 CFU/mL, 34 CFU/mL and 2 CFU/mL. Furthermore, all target bacteria in samples containing 8 × 108 CFU/mL of other interfering bacteria have been successfully identified and quantified. The proposed method was also successfully applied to the detection of bacterial infection in skin wounds of mouse and human, including the detection of separate bacterial infection as well as a coinfection. The recovery of this method was in the range of 90.161– 109.961%. Thus, this proposed method can be a promising candidate for rapid and convenient evaluation of infectious bacteria in point-of-care settings.

Keywords: Platinum nanoparticles; Fluorescent biosensor; Aptamer; Wound; Bacterial infection

Hiroki Hayashi[a], Mayuri Fujita[a], Shigeki Kuroiwa[b], Keishi Ohashi[b], Masahisa Okada[cd], Futoshi Shibasaki[cd], Tetsuya Osaka[a], Toshiyuki Momma[ab] (a. Graduate School of Advanced Science and Engineering, Waseda University, Okubo 3-4-1, Shinjuku-ku, Tokyo 169-8555, Japan, b. Research Organization for Nano & Life Innovation, Waseda University, Wasedatsurumakicho 513, Shinjuku, Tokyo 162-0041, Japan, c. Molecular Medical Research Project, Department of Genome Medicine, Tokyo Metropolitan Institute of Medical Science, Kamikitazawa 2-1-6, Setagaya-ku, Tokyo 156-8506, Japan, d. Tokyo Biomarker Innovation Research Association, Kudan-Minami 1-5-10, Chiyoda-ku, Tokyo 102-0074, Japan). Semiconductor-based biosensor exploiting competitive adsorption with charged pseudo-target molecules for monitoring 5-fluorouracil concentration in human serum. Sensors and Actuators B: Chemical, Volume 395 (2023): 134495

Rapid and simple monitoring of anticancer drug concentrations in blood is important for improving the efficacy of chemotherapeutic cancer treatment. In this study, we demonstrated the detection of 5-fluorouracil (5-FU) in human serum using a field-effect transistor (FET) biosensor with competitive adsorption between uncharged anticancer drugs and charged pseudo-targets. The target 5-FU and 5-FU-modified bovine serum albumin (BSA/5-FU) were competitively adsorbed on the FET sensor surface using antigen-antibody reaction with antigen-binding fragment (Fab) receptor. FET responses to the target 5-FU concentrations were obtained via changes in the amount of negatively charged BSA/5-FU captured by Fab molecules. In addition, the influence of serum components could be suppressed by diluting the samples with a nonionic surfactant solution. As a result, the FET biosensing system was capable of quantitatively detecting 5-FU concentrations in serum. Therefore, the semiconductor-based sensing system could enable the adjustment of anticancer drug dosages and potentially lead to improvements in anticancer drug therapy.

Keywords: Field-effect transistor biosensors; Competitive adsorption; Uncharged target; 5-fluorouracil; Human serum

Hanbin Park[a], Nayeon Kwon[a], Goeun Park[a], Moonbong Jang[a], Yein Kwon[a], Yejin Yoon[a], Jeongyun An[a], Junhong Min[b], Taek Lee[a] (a. Department of Chemical Engineering, Kwangwoon University, 20 Kwangwoon-Ro, Nowon-Gu, Seoul 01897, Republic of Korea, b. School of Integrative Engineering Chung-Ang University, Heukseok-dong, Dongjak-gu, Seoul 06974, Republic of Korea). **Fast-response electrochemical biosensor based on a truncated aptamer and MXene heterolayer for West Nile virus detection in human serum. Bioelectrochemistry, Volume 154 (2023): 108540**

West Nile virus (WNV) is a mosquito-borne flavivirus that can cause West Nile fever, meningitis, encephalitis, and polio. Early detection of WNV is important to prevent infection spread on the field. To commercialize the electrochemical biosensor for WNV, rapid target detection with the cheap manufacture cost is essential. Here, we developed a fast-response electrochemical biosensor consisting of a truncated WNV aptamer/MXene (Ti3C2Tx) bilayer on round-type micro gap. To reduce the target binding time, the application of the alternating current electrothermal flow (ACEF) technology reduced the target detection time to within 10 min, providing a rapid biosensor platform. The MXene nanosheet improved electrochemical signal amplification, and the aptamer produced through systematic evolution of ligands by exponential enrichment process eliminated unnecessary base sequences via truncation and lowered the manufacturing cost. Under optimized conditions, the WNV limit of detection (LOD) and selectivity were measured using electrochemical measurement methods, including cyclic voltammetry and square wave voltammetry. The LOD was 2.57 pM for WNV diluted in deionized water and 1.06 pM for WNV diluted in 10% human serum. The fabricated electrochemical biosensor has high selectivity and allows rapid detection, suggesting the possibility of future application in the diagnosis of flaviviridae virus.

Keywords: Aptamer truncation; West Nile virus; ACEF; Rapid biosensor; Electrochemical biosensor; SELEX

Irina V. Safenkova [1], Alexey V. Samokhvalov [1], Kseniya V. Serebrennikova [1], Sergei A. Eremin [1,2], Anatoly V. Zherdev [1] and Boris B. Dzantiev [1,*]. ([1]A.N. Bach Institute of Biochemistry, Research Centre of Biotechnology of the Russian Academy of Sciences, Moscow 119071, Russia, [2]Faculty of Chemistry, M.V. Lomonosov, Moscow State University, Moscow 119991, Russia). **DNA Probes for Cas12a-Based Assay with**

Fluorescence Anisotropy Enhanced Due to Anchors and Salts, *Biosensors, 13*(12) (2023): 1034

CRISPR/Cas12a is a potent biosensing tool known for its high specificity in DNA analysis. Cas12a recognizes the target DNA and acquires nuclease activity toward single-stranded DNA (ssDNA) probes. We present a straightforward and versatile approach to transforming common Cas12a-cleavable DNA probes into enhancing tools for fluorescence anisotropy (FA) measurements. Our study involved investigating 13 ssDNA probes with linear and hairpin structures, each featuring fluorescein at one end and a rotation-slowing tool (anchor) at the other. All anchors induced FA changes compared to fluorescein, ranging from 24 to 110 mr. Significant FA increases (up to 180 mr) were obtained by adding divalent metal salts (Mg^{2+}, Ca^{2+}, Ba^{2+}), which influenced the rigidity and compactness of the DNA probes. The specific Cas12a-based recognition of double-stranded DNA (dsDNA) fragments of the bacterial phytopathogen *Erwinia amylovora* allowed us to determine the optimal set (probe structure, anchor, concentration of divalent ion) for FA-based detection. The best sensitivity was obtained using a hairpin structure with dC10 in the loop and streptavidin located near the fluorescein at the stem in the presence of 100 mM Mg^{2+}. The detection limit of the dsDNA target was equal to 0.8 pM, which was eight times more sensitive compared to the common fluorescence-based method. The enhancing set ensured detection of single cells of *E. amylovora* per reaction in an analysis based on CRISPR/Cas12a with recombinase polymerase amplification. Our approach is universal and easy to implement. Combining FA with Cas12a offers enhanced sensitivity and signal reliability and could be applied to different DNA and RNA analytes.

Keywords: CRISPR/Cas12; trans-cleavage; ssDNA probe; DNA trans-target; hairpin probe; G-quadruplex; fluorescence polarization

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Human serum albumin (HSA) is not electroactive, because the electroactive amino acids have been buried in its structure. Therefore, direct electrochemical determination of the HSA as the most abundant protein in human plasma cannot be performed. In this work, a novel electrochemical biosensor has been developed based on synthesis of dual templates molecularly imprinted polymers (DTMIPs) having trypsin (TRP) and HSA as template molecules onto the surface of a glassy carbon electrode (GCE) modified with graphene-ionic liquid (Gr-IL). By incubation of the biosensor with TRP, and HSA, tryptic hydrolysis of the HSA is occurred which breaks the HSA down into free amino acids. The HSA involves five electroactive amino acids including cysteine, tryptophan, tyrosine, methionine and histidine whose differential normal pulse voltammetric (DNPV) responses are overlapped and generated a single peak. In order to increase the sensitivity of the DTMIP/Gr-IL/GCE for determination of the HSA, hydrodynamic DNPV (HDNPV) data were generated, and used for analytical purposes. The second-order HDNPV data were generated at different pulse amplitudes and used to develop four second-order calibration models by multivariate curve resolution-alternating least squares (MCR-ALS),

parallel factor analysis2 (PARAFAC2), multi-way partial least squares/residual bilinearization (N-PLS/RBL), and unfolded partial least squares/residual bilinearization (U-PLS/RBL) to select the best procedure for determination of the HSA in the presence of gamma-globulin and glucose as uncalibrated interferences. The results confirmed the best performance for the biosensor assisted by MCR-ALS for ultrasensitive and selective determination of the HSA in both synthetic and real matrices which was comparable with HPLC-UV as a reference method.

Keywords: Human serum albumin; Biosensor; Second-order calibration; Differential normal pulse voltammetry

Goeun Park[a], Hoseok Lee[b], Moonbong Jang[a], Jeong Ah Park[a], Hanbin Park[a], Chulhwan Park[a], Tae-Hyung Kim[c], Min-Ho Lee[c], Taek Lee[a]. (a. Department of Chemical Engineering, Kwangwoon University, 20 Kwangwoon-Ro, Nowon-Gu, Seoul 01897, the Republic of Korea, b. Department of Electrical and Computer Engineering, Seoul National University, 1 Gwanak-ro, Gwanak-gu, 08826 Seoul, the Republic of Korea, c. School of Integrative Engineering, Chung-Ang University, Dongjak-Gu, Seoul 06974, the Republic of Korea). Rapid electrical biosensor consisting of DNA aptamer/carbon nanonetwork on microelectrode array for cardiac troponin I in human serum. Sensors and Actuators B: Chemical, Volume 393 (2023): 134295

Rapid detection of cardiac biomarkers is important for the early diagnosis of acute myocardial infarction (AMI). Currently, cardiac troponin I (cTnI) is the standard biomarker for precise diagnosis of AMI. It is essential for rapid diagnosis of AMI patient. Herein, we presented the rapid electrical biosensor composed of a carbon nanotube network (CNN) and DNA aptamer on a microelectrode array to detect cTnI in human serum sample. The island-shaped Au microgap electrodes array was used to provide a high signal-to-noise ratio response and maximize detection sensitivity. In addition, an alternating current electrothermal flow (ACEF) method was introduced to improve the affinity between the DNA aptamer and the target molecule, and cTnI was detected within 10 min using this method. The current change was analyzed using pulse measurement for 100 μs, and the integrated current method was proposed to improve the performance of the sensor platform. This biosensor can detect cTnI in a wide linear range from 1 pM to 100 nM in 10 % human serum. The limit of detection is 6.59 fM, indicating high selectivity. Thus, the proposed electrical biosensor platform may facilitate rapid and early detection of AMI in the future.

Keywords: Acute myocardial infarction (AMI); Cardiac troponin I (cTnI); Carbon nanotube network (CNN); Alternating current electrothermal flow (ACEF); Aptasensor

Reyhaneh Aziziyan, Homeira Ebrahimzadeh, Fatemeh Nejabati. (Department of Analytical Chemistry and Pollutants, Faculty of Chemistry and Petroleum Sciences, Shahid Beheshti University, Tehran, Iran). Simultaneous determination of trace amounts of dopamine and uric acid in human plasma samples with novel voltammetric biosensor (GCE/Ppy/DEA MIP) following the thin film-μSPE method based on electrospun nanofibers. Microchemical Journal, Volume 194 (2023): 109235

In order to achieve the aim of this study, i.e., simultaneous measurement of trace amounts of dopamine (DA) and uric acid (UA) following their preconcentration, a novel sorbent with high performance was prepared. Hence, herein, poly vinyl chloride/Mg-Al layered double hydroxide (PVC/Mg-Al LDH) electrospun nanofibers were synthesized for the thin film- micro solid phase extraction (TF-μSPE) and then, simultaneous extraction of trace amounts of DA and UA was done. Finally, DA and UA were determined simultaneously from two different human plasma samples; afterwards, glassy carbon electrode/Poly pyrrole/diethylamine (DA, UA) molecularly-

imprinted polymer (GCE/Ppy/DEA (DA, UA) MIP) electrochemical biosensor was constructed. The synthesis confirmation of PVC-Mg-Al LDH electrospun nanofibers was accomplished by scanning electron microscopy (SEM), energy-dispersive X-ray (EDX) spectroscopy, X-ray diffraction (XRD) and attenuated total reflection-Fourier transform infrared (ATR-FTIR). In addition, the GCE/Ppy/DEA MIP and GCE/Ppy/DEA (non-imprinted polymer) NIP nanocomposites were characterized with field emission-scanning electron microscopy (FE-SEM). PVC, as a polymer with a large surface area and high porosity, is an appropriate candidate in the sorbent preparation process with electrospinning. The flexible interlayer region is accessible to various anionic and polar molecular species. Adding Mg-Al LDH led to an extensive surface area of electrospun nanofibers. In the case of Ppy and DEA MIP as GCE surface modifiers, Ppy increased the electroactive sites, leading to the high conductivity of the electrochemical biosensor. Besides, DEA MIP has high selectivity and sensitivity. Optimization of impressive factors on the extraction procedure was conducted by one at-time (OAT) method, and optimum conditions for the construction of electrochemical biosensor were attained with experimental design (design-expert 12.0 software). According to the optimum conditions, the wide linear range was obtained 76.6–268.1 µg mL−1 for DA and 84.1–378.2 µg mL−1 for UA with R2 ≥ 0.96, low detection limits ranged from 22.3 µg mL–1 for DA and 24.8 µg mL−1 for UA based on S/N = 3 and large enrichment factors. The intra-day (n = 3) and inter-day (n = 3) RSDs% were obtained in the span of 5.3% − 6.1% for DA and 4.0% − 5.6% for UA. Eventually, the efficiency of the TF-µSPE-voltammetric biosensor method was evaluated for the measuring of DA and UA in human plasma samples with satisfactory recoveries (90.2%–99.7%).

Keywords: Electrochemical Biosensor; Mg-Al layered double hydroxide; Thin film- micro solid phase extraction; Molecularly-imprinted polymer (MIP); Poly vinyl chloride; Poly pyrrole

Iulia Corina Ciobotaru [1], Daniela Oprea [1,2], Constantin Claudiu Ciobotaru [1] and Teodor Adrian Enache [1,*]. ([1]National Institute of Materials Physics, 405A Atomistilor, 077125 Magurele, Romania, [2]Faculty of Physics, University of Bucharest, 405 Atomistilor, 077125 Magurele, Romania). **Low-Cost Plant-Based Metal and Metal Oxide Nanoparticle Synthesis and Their Use in Optical and Electrochemical (Bio)Sensors.** ***Biosensors, 13*(12)(2023):, 1031**

Technological progress has led to the development of analytical tools that promise a huge socio-economic impact on our daily lives and an improved quality of life for all. The use of plant extract synthesized nanoparticles in the development and fabrication of optical or electrochemical (bio)sensors presents major advantages. Besides their low-cost fabrication and scalability, these nanoparticles may have a dual role, serving as a transducer component and as a recognition element, the latter requiring their functionalization with specific components. Different approaches, such as surface modification techniques to facilitate precise biomolecule attachment, thereby augmenting recognition capabilities, or fine tuning functional groups on nanoparticle surfaces are preferred for ensuring stable biomolecule conjugation while preserving bioactivity. Size optimization, maximizing surface area, and tailored nanoparticle shapes increase the potential for robust interactions and enhance the transduction. This article specifically aims to illustrate the adaptability and effectiveness of these biosensing platforms in identifying precise biological targets along with their far-reaching implications across various domains, spanning healthcare diagnostics, environmental monitoring, and diverse bioanalytical fields. By exploring these applications, the article highlights the significance of prioritizing the use of natural resources for nanoparticle synthesis. This emphasis aligns with the worldwide goal

of envisioning sustainable and customized biosensing solutions, emphasizing heightened sensitivity and selectivity.

Keywords: green synthesis; metal nanoparticles; plant extracts; optical (bio)sensors; electrochemical (bio)sensors

Bioengineering

Eléonore Mira[ab], Alain Rousteau[b], Régis Tournebize[c], Marie Robert[d], André Evette[a] (a. Univ. Grenoble Alpes, INRAE, LESSEM, F-38402 St-Martin-d'Hères, France, b. UA, UMR EcoFoG, CNRS, Cirad, INRAE, Université des Antilles, Université de Guyane, Université des Antilles, 97159 Pointe à Pitre, Guadeloupe, France, c. INRAE, UR ASTRO, 97170 Petit-Bourg, Guadeloupe, France, d. Parc national de la Guadeloupe, Habitation Beausoleil, Montéran, 97120 Saint-Claude, Guadeloupe). Herbaceous angiosperms, pteridophytes and shrubs cocktail for rapid ground cover for soil and water bioengineering in the Caribbean. Ecological Engineering, Volume 196 (2023): 107106

Among the Nature-based Solutions currently spreading worldwide, soil and water bioengineering techniques, are used to stabilize hill slopes, earth embankment, and riverbanks. They consist in the use of living plants, sometimes coupled with dead materials, to control erosion and restore ecosystems. These approaches remain to be adapted to Neotropics and particularly to the Caribbean Islands biodiversity hotspot. The success of soil and water bioengineering designs depends on the selection of suitable native plant species and considering the hydrodynamic and geotechnical processes. In the Caribbean, data are available concerning woody species but are still lacking for the other constitutive components of riparian plant communities. The objective of this study was to identify the riparian forest understory species best suited for use in SWBE at their establishment phase. In a three-month ex situ experiment, we measured the survival rate, biomass production and root growth of propagules (cuttings and bulbils) of eleven native Caribbean species (5 herbs, 4 pteridophytes, 2 shrubs) occurring naturally in a variety of riparian environments. All the herb and shrub species studied displayed growth vigour adequate for a successful inclusion in soil and water bioengineering techniques. Among herbs, Commelina diffusa, Hymenachne amplexicaulis and Sphagneticola trilobata performed the best. Gynerium sagittatum and Dieffenbachia seguine, despite their slower growth and root development, remain suitable. Regarding the two shrubs, Ludwigia octovalvis gave better results than Clidemia hirta. Among the pteridophytes, Adiantum latifolium, Thelypteris reticulata and particularly Lycopodium cernuum appeared poorly suited to soil and water bioengineering. Acrostichum danaeifolium was the best-performing pteridophyte. These first experimental results focusing on the propagation and establishment of native herbs, pteridophytes and shrubs, allowed to identify a diversity of species of interest as cuttings for soil and water bioengineering and practical clues for their use in the Neotropics.

Keywords: Soil and water bioengineering; Guadeloupe; Nature-based solution; Riparian vegetation; Survival rate; Biomass

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for Orthopedics and Trauma Surgery, Bethlehem Health Center Stolberg, 52222 Stolberg, Germany). The Influence of Sagittal Pin Angulation on the Stiffness and Pull-Out Strength of a Monolateral Fixator Construct. Bioengineering, 10(8) (2023): 982

Monolateral pin-to-bar-clamp fixators are commonly used to stabilize acute extremity injuries. Certain rules regarding frame geometry have been established that affect construct stability. The influence of sagittal pin angulation on construct stiffness and strength has not been investigated. The purpose of this biomechanical study was to demonstrate the effect of a pin angulation in the monolateral fixator using a composite cylinder model. Three groups of composite cylinder models with a fracture gap were loaded with different mounting variants of monolateral pin-to-bar-clamp fixators. In the first group, the pins were set parallel to each other and perpendicular to the specimen. In the second group, both pins were set convergent each in an angle of 15° to the specimen. In the third group, the pins were set each 15° divergent. The strength of the constructions was tested using a mechanical testing machine. This was followed by a cyclic loading test to produce pin loosening. A pull-out test was then performed to evaluate the strength of each construct at the pin–bone interface. Initial stiffness analyses showed that the converging configuration was the stiffest, while the diverging configuration was the least stiff. The parallel mounting showed an intermediate stiffness. There was a significantly higher resistance to pull-out force in the diverging pin configuration compared to the converging pin configuration. There was no significant difference in the pull-out strength of the parallel pins compared to the angled pin pairs. Convergent mounting of pin pairs increases the stiffness of a monolateral fixator, whereas a divergent mounting weakens it. Regarding the strength of the pin–bone interface, the divergent pin configuration appears to provide greater resistance to pull-out force than the convergent one. The results of this pilot study should be important for the doctrine of fixator mounting as well as for fixator component design.

Keywords: biomechanics; monolateral fixator; pin angulation; stiffness; pull-out strength

Victor A. Convertino [1,2,3,*], Eric J. Snider [4], Sofia I. Hernandez-Torres [4], James P. Collier [4], Samantha K. Eaton [4], David R. Holmes III [5], Clifton R. Haider [6] and Jose Salinas [4] . ([1]Battlefield Health & Trauma Center for Human Integrative Physiology, US Army Institute of Surgical Research, JBSA Fort Sam Houston, San Antonio, TX 78234, USA, [2]Department of Medicine, Uniformed Services University of the Health Sciences, Bethesda, MD 20814, USA, [3]Department of Emergency Medicine, University of Texas Health, San Antonio, TX 78229, USA, [4]Organ Support & Automation Technology Research Team, JBSA Fort Sam Houston, San Antonio, TX 78234, USA, [5]Biomedical Analytics and Computational Engineering Laboratory, Mayo Clinic, Rochester, MN 55905, USA, [6]Special Purpose Processor Development Group, Mayo Clinic, Rochester, MN 55905, USA). **Verification and Validation of Lower Body Negative Pressure as a Non-Invasive Bioengineering Tool for Testing Technologies for Monitoring Human Hemorrhage. Bioengineering, 10(10) (2023): 1226**

Since hemorrhage is a leading cause of preventable death in both civilian and military settings, the development of advanced decision support monitoring capabilities is necessary to promote improved clinical outcomes. The emergence of lower body negative pressure (LBNP) has provided a bioengineering technology for inducing progressive reductions in central blood volume shown to be accurate as a model for the study of the early compensatory stages of hemorrhage. In this context, the specific aim of this study was to provide for the first time a

systematic technical evaluation to meet a commonly accepted engineering standard based on the FDA-recognized Standard for Assessing Credibility of Modeling through Verification and Validation (V&V) for Medical Devices (ASME standard V&V 40) specifically highlighting LBNP as a valuable resource for the safe study of hemorrhage physiology in humans. As an experimental tool, evidence is presented that LBNP is credible, repeatable, and validated as an analog for the study of human hemorrhage physiology compared to actual blood loss. The LBNP tool can promote the testing and development of advanced monitoring algorithms and evaluating wearable sensors with the goal of improving clinical outcomes during use in emergency medical settings.

Keywords: lower body negative pressure; hemorrhage; hypovolemia; shock; medical monitoring; wearable sensors

Luís Pinto-Coelho [1,2]. ([1]ISEP—School of Engineering, Polytechnic Institute of Porto, 4200-465 Porto, Portugal, [2]INESCTEC, Campus of the Engineering Faculty of the University of Porto, 4200-465 Porto, Portugal). How Artificial Intelligence Is Shaping Medical Imaging Technology: A Survey of Innovations and Applications. *Bioengineering* 2023, *10*(12), 1435

The integration of artificial intelligence (AI) into medical imaging has guided in an era of transformation in healthcare. This literature review explores the latest innovations and applications of AI in the field, highlighting its profound impact on medical diagnosis and patient care. The innovation segment explores cutting-edge developments in AI, such as deep learning algorithms, convolutional neural networks, and generative adversarial networks, which have significantly improved the accuracy and efficiency of medical image analysis. These innovations have enabled rapid and accurate detection of abnormalities, from identifying tumors during radiological examinations to detecting early signs of eye disease in retinal images. The article also highlights various applications of AI in medical imaging, including radiology, pathology, cardiology, and more. AI-based diagnostic tools not only speed up the interpretation of complex images but also improve early detection of disease, ultimately delivering better outcomes for patients. Additionally, AI-based image processing facilitates personalized treatment plans, thereby optimizing healthcare delivery. This literature review highlights the paradigm shift that AI has brought to medical imaging, highlighting its role in revolutionizing diagnosis and patient care. By combining cutting-edge AI techniques and their practical applications, it is clear that AI will continue shaping the future of healthcare in profound and positive ways.

Keywords: artificial intelligence; medical imaging; review; diagnostics; segmentation; classification

Y.T. Tang[a], S.G. Yin[a], C.F. Peng[a], J.Y. Tang[a], G. Jia[a], L.Q. Che[a], G.M. Liu[a], G. Tian[a], X.L. Chen[a], J.Y. Cai[a], B. Kang[b], H. Zhao[a]. (a. Key Laboratory for Animal Disease-Resistance Nutrition of Ministry of Education of China, Ministry of Agriculture and Rural Affairs of Sichuan Province, Animal Nutrition Institute, Sichuan Agricultural University, Chengdu 611130, Sichuan, China, b. College of Animal Science and Technology, Sichuan Agricultural University, Chengdu 611130, Sichuan, China). Compound bioengineering protein supplementation improves intestinal health and growth performance of broilers. Poultry Science, Volume 102, Issue 11 (2023): 103037

Currently, antimicrobial peptides (AMPs) are of growing interest as potential substitutes for antibiotic growth promoters in animal production. The present study was conducted to evaluate the effects of dietary supplementation of bioengineering artificial Parasin I protein (API) and artificial plectasin protein (APL) (named as compound bioengineering protein, CBP) on growth performance and intestinal health of broilers. A total of 450 one-day-old Arbor Acres male

healthy broilers were randomly allotted to 5 dietary groups with 10 replicates of 9 individuals in each replicate and supplemented with 0, 250, 500, 750, and 1,000 mg/kg CBP for 6 wk. Dietary CBP supplementation increased ($P < 0.01$) body weight (6 wk), average daily gain (0–6 wk), and average daily feed intake (3–6 wk and 0–6 wk). CBP addition enhanced antioxidant capacity, which was accompanied by the higher ($P < 0.05$) activity of serum total antioxidant capacity (T-AOC) (750 mg/kg), jejunal glutathione peroxidase (750 mg/kg), and T-AOC (500 and 1,000 mg/kg). Dietary CBP addition improved intestinal health, reflecting by the increased ($P < 0.05$) villus height to crypt depth ratio in the duodenum, the upregulated ($P < 0.01$) mRNA levels of claudin-1 (500 and 750 mg/kg) in the ileum, the downregulated ($P < 0.01$) mRNA expression of occludin (500 mg/kg) in the duodenum and claudin-1 (500 mg/kg) and occludin (500 and 750 mg/kg) in the jejunum, and the upregulated mRNA expression of ($P < 0.01$) mucin2 (MUC2) (1,000 mg/kg) in the duodenum. In addition, CBP upregulated ($P < 0.01$) IL-10 (1,000 mg/kg) in duodenum and ileum, and downregulated ($P < 0.05$) the mRNA expression of IL-6 (750 and 1,000 mg/kg), interferon-γ (1,000 mg/kg) in the jejunum and TNF-α (250 mg/kg) in the ileum. Furthermore, dietary CBP increased ($P < 0.01$) the abundance of total bacteria and Lactobacillus (500 and 750 mg/kg), and reduced ($P < 0.05$) the abundance of Escherichia coli (750 mg/kg) in the cecum. In conclusion, CBP supplementation enhances the antioxidant capacity, intestinal health, immune function, and ameliorates the gut microflora population, thus improving the growth performance of broilers. Dietary supplementation of 750 mg/kg CBP exhibits a better beneficial effect.

Keywords: bioengineering protein; antimicrobial peptide; broiler; growth performance; intestinal health

Pollen Biotechnology

Wenqi Yang[16], Dongdong Yao[16], Haiyang Duan[26], Junli Zhang[12], Yaling Cai[1], Chen Lan[1], Bing Zhao[1], Yong Mei[1], Yan Zheng[1], Erbing Yang[4], Xiaoduo Lu[5], Xuehai Zhang[2], Jihua Tang[23], Ke Yu[1], Xuebin Zhang[1] (1. State Key Laboratory of Crop Stress Adaptation and Improvement, Henan Joint International Laboratory for Crop Multi-Omics Research, School of Life Sciences, Henan University, Kaifeng 475004, China, 2. National Key Laboratory of Wheat and Maize Crop Science, College of Agronomy, Henan Agricultural University, Zhengzhou 450002, China, 3. The Shennong Laboratory, Zhengzhou 450002, China, 4. College of Chemistry, Zhengzhou University, Zhengzhou 450001, China, 5. National Engineering Laboratory of Crop Stress Resistance, School of Life Science, Anhui Agricultural University, Hefei 230036, China). VAMP726 from maize and Arabidopsis confers pollen resistance to heat and UV radiation by influencing lignin content of sporopollenin. Plant Communications, Volume 4, Issue 6 (2023): 100682

Sporopollenin in the pollen cell wall protects male gametophytes from stresses. Phenylpropanoid derivatives, including guaiacyl (G) lignin units, are known to be structural components of sporopollenin, but the exact composition of sporopollenin remains to be fully resolved. We analyzed the phenylpropanoid derivatives in sporopollenin from maize and Arabidopsis by thioacidolysis coupled with nuclear magnetic resonance (NMR) and gas chromatography–mass spectrometry (GC–MS). The NMR and GC–MS results confirmed the presence of p-

hydroxyphenyl (H), G, and syringyl (S) lignin units in sporopollenin from maize and Arabidopsis. Strikingly, H units account for the majority of lignin monomers in sporopollenin from these species. We next performed a genome-wide association study to explore the genetic basis of maize sporopollenin composition and identified a vesicle-associated membrane protein (ZmVAMP726) that is strongly associated with lignin monomer composition of maize sporopollenin. Genetic manipulation of VAMP726 affected not only lignin monomer composition in sporopollenin but also pollen resistance to heat and UV radiation in maize and Arabidopsis, indicating that VAMP726 is functionally conserved in monocot and dicot plants. Our work provides new insight into the lignin monomers that serve as structural components of sporopollenin and characterizes VAMP726, which affects sporopollenin composition and stress resistance in pollen.

Keywords: pollen cell wall; sporopollenin; lignin monomers; heat stress; UV radiation

Feng Liu[a], Huiting Yang[a], Rong Tang[a], Wang Wang[a], Haodong Shen[a], Mengxue Xu[a], Tiancheng Hao[a], Yuanyuan Hu[a], Yunhui Zhang[b], Yiqun Bao[a]. (a. College of Life Sciences, Nanjing Agricultural University, Nanjing 210095, PR China, b. Provincial Key Laboratory of Agrobiology, Institute of Germplasm Resources and Biotechnology, Jiangsu Academy of Agricultural Sciences, Nanjing, PR China). OsTKPR1 proteins with a single amino acid substitution fail the synthesis of a specific sporopollenin precursor and cause abnormal exine and pollen development in rice. Plant Science, Volume 335(2023): 111792

Fatty acid derivatives are key components of rice pollen exine. The synthesis of aliphatic sporopollenin precursors are initiated in the plastids of the tapetal cells, followed by multiple-step reactions conducted in the endoplasmic reticulum (ER). However, the relative contribution of different precursors to the precise structure of sporopollenin remains largely elusive, let alone the underlying mechanism. Here, we report that two complete male sterile mutants ostkpr1–3 (Tetraketide α-pyrone reductase 1–3, with OsTKPR1P124S substitution) and ostkpr1–4 (with truncated OsTKPR1stop) are defective in pollen exine, Ubisch body and anther cuticle development where ostkpr1–4 display severer phenotypes. Remarkably, OsTKPR1 could produce reduced hydroxylated tetraketide α-pyrone and reduced tetraketide α-pyrone, whereas OsTKPR1P124S fails to produce the latter. Pairwise interaction assays show that mutated OsTKPR1P124S is able to integrate into a recently characterized metabolon, thus its altered catalytic activity is not due to dis-integrity of the metabolon. In short, we find that reduced tetraketide α-pyrone is a key sporopollenin precursor required for normal exine formation, and the conserved 124th proline of OsTKPR1 is essential for the reduction activity. Therefore, this study provided new insights into the sporopollenin precursor constitution critical for exine formation.

Keywords: OsTKPR1P124S; Pollen exine; Reduced tetraketide α-pyrone; Rice; Sporopollenin

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Ebonyi State, Federal Republic of Nigeria). Phenology, floral organs ultra-structure, traits correlation, stigma receptiveness, pollen viability and germinability in horsegram (Macrotyloma uniflorum Lam.) Verdc. South African Journal of Botany, Volume 161(2023): 444-453

The absence of information on the reproductive biology of some nutritive legumes has been an obstacle to their genetic improvement. Gathering information on reproductive biology contributes significantly to the interest of breeders to have adequate tools for initiating the improvement program through crosses among high performing genotypes. To contribute to this, we examined the flowering phenology, pollen biology, stigma receptiveness at bud dehiscence and anthesis phases, and the in-vitro germination of the pollens in horsegram (Macrotyloma uniflorum). Pollens of horsegram were found to be either tricolporate or triporate, echinates in all accessions except in the collections from Benin. Ovaries in horsegram showed great variation in the number of ovules and activities of peroxidase indicated the receptiveness of stigma at bud dehiscence phase and during anthesis. A high number of ovules per ovary was found in accessions from Australia (Leichardt 1 and 2), Mali (LeichardtMali) and India (CPI22679). Pollen viability analysis implies the possibility of better results when pollinating during the day and immediately after the flower opens. The study provides information on the reproductive biology of horsegram for future hybridization program in order to enhance the performance of the crop and increase production. It also reveals differences in accessions from Benin compared with all other accessions from Mali, India or Australia.

Keywords: Horsegram; Pollen; Stigma receptivity; Cultivars; Dehiscence; Macrotyloma uniflorum

J. Eakins[ab], M. Lynch[a], J.C. Carolan[b], N.J. Rowan[a] (a. Centre for Disinfection and Sterilization, Faculty of Science and Health, Technological Institute of the Shannon, Midlands Campus, Ireland, b. Department of Biology, Maynooth University, Maynooth, Co. Kildare, Ireland). Studies on the novel effects of electron beam treated pollen on colony reproductive output in commercially-reared bumblebees (Bombus terrestris) for mass pollination applications. Science of The Total Environment, Volume 899 (2023): 165614

Commercially-reared bumblebees provide an important pollinator service that helps support food production and security. The deployment of an appropriate non-thermal disinfection technology for the bulk treatment of pollen collected from honeybees for the feeding of commercial bumblebees is important in order to mitigate against complex diseases and unwanted pathogen spillover to native bees. High level disinfection of pollen was achieved using an electron (e)-beam dose of 100 kGy that corresponded to 78 % loss of cellular viability of bee pathogens before feeding to bumblebees as measured by the novel in vitro use of flow cytometry (FCM). Novel findings showed that e-beam treated-pollen that was fed to bumblebees produced fewer females, gynes and exhibited an absence of males when compared to control bumblebee colonies that were fed untreated commercial pollen. A similar trend emerged in bumblebee colony reproductive outputs when using membrane filtered washed pollen. Proteomic analysis of bumblebees from individual colonies fed with treated-pollen revealed a differential abundance of proteins associated with stress, immunity and metabolism when compared to the untreated pollen control group. Microbiome analysis of the bumblebee gut content revealed differences in microbiota between treated and untreated pollen in bumblebee colony studies. This novel study evaluated the impact of industrial e-beam treated-pollen on complex bee disease mitigation

where physically treated-pollen fed to bumblebees was shown to substantially affect colony reproductive outputs.

Keywords: Pollination; Commercial bumblebees; Pollen; electron-beam; Colony reproductive outputs; Food security

Biotechnology Policy Issue

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Bio-based fertilisers (BBFs) aim to reduce the European Union's (EU) dependence on imported mineral fertilisers by recycling and reusing nutrient-rich by-streams. However, implementation can be very complex, and the right policies must be delivered to optimize BBFs' production-consumption flows. This study seeks a new perspective for policymakers by understanding current policies and reviewing previous studies on BBFs' implementation. Data collection from the researchers' database plus additional information from the "EU-Lex" platform and Member States' Government websites were obtained to fulfil the critical analysis. Our reviews indicate that policies related to BBFs are still under development to comply with some appropriate laws and regulations for their implementation. The current policies, implemented among others by the new EU Fertilising Products Regulation (FPR), are structured by component material categories (CMC) and product function categories (PFC) that govern the specific function of the product and the raw material utilization. For farmers and Small and Medium Enterprises (SMEs), compliance with the FPR may be challenging. Yet, for regional use, farmers and producers can still rely on BBFs in compliance with national regulations. In addition, attention from policymakers is needed to increase the level of public acceptance, farmer's adoption, and availability of BBF with acceptable prices. Finally, this study provides prospective research opportunities to help the development of BBFs.

Keywords: Fertiliser regulation, Future fertiliser, Circular economy framework

Agricultural Biotechnology

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Cellulose aerogel (CA) is considered to be the most promising material due to its extraordinary properties like unique microstructure, porosity, large specific surface area, biodegradability, renewable nature and lightweight. Cellulosic aerogels are thus found to have potential applications in different fields especially in water purification and biomedical field. Agricultural waste based cellulose aerogels are recently getting wider attention owing to its sustainability. The synthesis methods of agri-waste based cellulose aerogels, its properties and application in different fields especially in the field of water purification are detailed in a comprehensive manner. This review tries to bring light into the commercialization of value-added products from sustainable, cheap agricultural waste material and tries to motivate young researchers.

Keywords: Agriculture, Biotechnology

Bioenergy

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Gasification of waste biomass can offer a cleaner and renewable alternative to wood and fossil fuel-based cooking systems. However, field evaluations of biomass gasifiers for institutional cooking are rarely reported in the scientific literature. This study was aimed to develop a fuel-efficient gasifier system for institutional cooking in the Indian context. We conducted field experiments in both rural and urban settings using collaborative approaches. The results demonstrated significant improvements in gasifier-based cooking including up to a 25% reduction in cooking time, about 28% lower fuel consumption, and 82% less fine particulate matter emissions, within the permissible limits, when compared to cooking via traditional chulha (clay stove). Through collaborative design with users, the gasifier system underwent further modifications to achieve a substantial reduction in cooking time (around 25–30%) across various testing scenarios. Furthermore, the gasifier system was successfully demonstrated to supplement a liquefied petroleum gas (LPG)-based cooking system, and the latter showed around 25% faster cooking performance and a 12.5% lower energy input. Practical problems encountered during biomass gasifier field trials were documented and analyzed, along with a project SWOT

(Strengths, Weaknesses, Opportunities, and Threats) analysis. The results of gasifier field trials imply significant potential when compared to the traditional cooking in a rural setting. Overall, the proposed gasifier system could serve as a sustainable technology alternative for bioenergy applications in the developing world.

Keywords: Bioenergy; Biomass gasification; Cooking fuel; Field case study; Participatory approach; SWOT analysis

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Despite a significant increase in United States biomass energy sector activity, including domestic bioenergy deployment and wood pellet production for overseas exports, the associated criteria pollutant emissions are not well quantified in current regulatory emissions inventories. We present an updated U.S. emissions inventory, with emphasis on wood-based biomass pretreatment (e.g., drying, condensing, storage of wood pellet) and the use of biomass for energy generation. As a significant number of wood pellet production facilities are not included in current inventories, we find that this sector's emissions could be potentially underestimated by a factor of two. Emissions from biomass-based facilities are on average up to 2.8 times higher than their non-biomass counterparts per unit energy. We estimate that 2.3 million people live within 2 km of a biomass facility and who could be subject to adverse health impacts from their emissions. Overall, we find that the bioenergy sector contributes to about 3–17% of total emissions from all energy, i.e., electric and non-electric generating facilities in the U.S. We also review some drivers of bioenergy expansion, such as various feedstocks and technologies deployed with an emphasis on wood-based bioenergy and discuss their implications for future air quality and health impacts.

Keywords: Biomass; Bioenergy; Renewable energy; Emissions inventory; Wood pellets

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We examine the supply chains of post-fire salvage harvest to 28 mills or 10 communities in British Columbia, Canada, and assess the net change in GHG emissions for community bioenergy and biofuels, relative to a ‘do-nothing’ baseline with fossil fuel use. Lowest-cost supply chains for post-fire salvage had largest hauled biomass for mills in the southern interior of the province, with mills in close proximity to each other having small fibresheds and low haul costs. Supply chains were also quantified for salvage biomass hauled to communities by using a lowest GHG optimization routine that selected between liquid transportation fuels or community bioenergy (heat and/or electricity). For the first few decades, avoided GHG emissions were larger when biomass was used for bioenergy (heat and/or electricity), mainly in larger communities, to avoid fossil fuel burning. As energy systems decarbonized, biomass was used for biofuels, and production was more evenly distributed amongst the communities. Adding these results to an integrated framework with previously published ecosystem emissions and removals assessed the net change in GHG emissions for a post-fire rehabilitation and bioenergy

scenario relative to a 'do-nothing' baseline with continued fossil fuel use. We found that there was an initial increase in net GHG emissions even though biogenic emissions from bioenergy were partially offset by avoided fossil fuel emissions. Over time, an enhanced sink from rehabilitation activities combined with avoided fossil fuel emissions resulted in a cumulative (2020–2070) GHG reduction at median levels of −6 $TgCO_2e$ with a range from reduced emissions of −39 $TgCO_2e$ to increased emissions 37 $TgCO_2e$. Cumulative avoided fossil emissions were −62 $TgCO_2e$ with a range from −49 $TgCO_2e$ to −86 $TgCO_2e$.

Keywords: Climate change mitigation; GCBM; Fire-killed salvage; Bioenergy; Biofuels; GHG emissions

Andrew James Welfle[ab], Alberto Almena[ac], Muhammad Naveed Arshad[ad], Scott William Banks[ac], Isabela Butnar[ae], Katie Jane Chong[ac], SamuelJ.G. Cooper[af], Helen Daly[ag], Samira Garcia Freites[ah], Fatih Güleç[ai], Christopher Hardacre[ag], Robert Holland[aj], Lan Lan[ag], Chai Siah Lee[ak], Peter Robertson[al], Rebecca Rowe[am], Anita Shepherd[an], Nathan Skillen[al], Silvia Tedesco[ao], Patricia Thornley[ac], Pedro Verdía Barbará[ap], Ian Watson[aq], Orla Sioned Aine Williams[ai], Mirjam Röder[ac] (a. UK Supergen Bioenergy Hub, UK, b. Tyndall Centre for Climate Change Research, The University of Manchester, UK, c. Energy and Bioproducts Research Institute, Aston University, UK, d. Institute of Biological, Environmental and Rural Sciences, Aberystwyth University, UK, e. UCL Institute for Sustainable Resources, University College London, UK, f. Centre for Sustainable and Circular Technologies, University of Bath, UK, g. Department of Chemical Engineering, University of Manchester, UK, h. Promigas, University of Manchester Alumni, Colombia, i. Faculty of Engineering, University of Nottingham, UK, j. University of Southampton, UK, k. Advanced Materials Research Group, University of Nottingham, UK, l. School of Chemistry and Chemical Engineering, Queen's University Belfast, UK, m. UK Centre for Ecology & Hydrology, UK, n. Institute of Biological and Environmental Sciences, University of Aberdeen, UK, o. Manchester Metropolitan University, UK, p. Department of Chemical Engineering, Imperial College London, UK, q. James Watt School of Engineering, University of Glasgow, UK). Sustainability of bioenergy – Mapping the risks & benefits to inform future bioenergy systems. Biomass and Bioenergy, Volume 177(2023): 106919

Bioenergy is widely included in energy strategies for its GHG mitigation potential. Bioenergy technologies will likely have to be deployed at scale to meet decarbonisation targets, and consequently biomass will have to be increasingly grown/mobilised. Sustainability risks associated with bioenergy may intensify with increasing deployment and where feedstocks are sourced through international trade. This research applies the Bioeconomy Sustainability Indicator Model (BSIM) to map and analyse the performance of bioenergy across 126 sustainability issues, evaluating 16 bioenergy case studies that reflect the breadth of biomass resources, technologies, energy vectors and bio-products. The research finds common trends in sustainability performance across projects that can inform bioenergy policy and decision making. Potential sustainability benefits are identified for People (jobs, skills, income, energy access); for Development (economy, energy, land utilisation); for Natural Systems (soil, heavy metals), and; for Climate Change (emissions, fuels). Also, consistent trends of sustainability risks where focus is required to ensure the viability of bioenergy projects, including for infrastructure, feedstock mobilisation, techno-economics and carbon stocks. Emission mitigation may be a primary objective for bioenergy, this research finds bioenergy projects can provide

potential benefits far beyond emissions - there is an argument for supporting projects based on the ecosystem services and/or economic stimulation they may deliver. Also given the broad dynamics and characteristics of bioenergy projects, a rigid approach of assessing sustainability may be incompatible. Awarding 'credit' across a broader range of sustainability indicators in addition to requiring minimum performances in key areas, may be more effective at ensuring bioenergy sustainability.

Keywords: Sustainable; Indicators; Biomass; Trends; Policy; Modelling

Giuseppe Pulighe, Tiziana Pirelli. (CREA Research Centre for Agricultural Policies and Bioeconomy, Via Barberini 36, Rome, Italy). Assessing the sustainability of bioenergy pathways through a land-water-energy nexus approach. Renewable and Sustainable Energy Reviews, Volume 184 (2023): 113539

Bioenergy can significantly contribute to facilitating the transition to a self-sufficient low-carbon energy sector in Europe. The establishment of sustainable bioenergy systems needs ex-ante analysis that considers specific contexts and potential trade-offs, including competing uses of natural resources such as land, water and energy. The use of marginal and underutilized lands has been emphasized as a valuable strategy to overcome the food vs fuel paradigm and the direct and indirect land use change that can derive from the cultivation of bioenergy crops. Nevertheless, the fragmentation of these lands can significantly affect the energy efficiency of the systems, due to increased energy needs for inputs and transport, with trade-offs on the carbon footprint of the pathway. This study performs an ex-ante assessment of the sustainability of a short bioenergy pathway through the Land-Water-Energy nexus approach, by the iterative use of a web geographic information systems platform, developed on the methodology of the Global Bioenergy Partnership. The simulations show that the production of bioenergy from oilseed crops is expected to reduce greenhouse gas emissions by 73% compared to the reference emission value for fossil fuels in transport. The platform proofs to be effective and user-friendly for assessing and optimizing the intricate interlinkages among the various nexus domains that coexist within the bioenergy system based on the cultivation of underutilized land. Its use can facilitate the nexus operationalization serving as a timesaving decision-support tool for the development of sustainable bioenergy systems that contribute to the transition towards a low-carbon energy sector in Europe.

Keywords: Environmental sustainability; Web-based platform; LCA; GIS; Bioenergy crops

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Bioenergy has the potential to substitute the current demand for fossil fuels in various applications. Recovering energy from bio-based materials due to environmental considerations has been adopted as a policy objective by governments and international organizations, which led to both vast financial investment and scientific research, especially in the last two decades. So far, various feedstocks and technologies have been scrutinised by the research community, although not all of them are commercially adopted due to sustainability considerations. This study employs scientometric analysis to survey the progress of scientific development in the

field of bioenergy from 1966 to 2022, using ten parameters including publication year, type of document, categories, countries, affiliations, document citations, co-authorship, author citation networks, journal citation networks, and keywords. A total of 51,905 scientific documents were collected from the Web of Science, involving more than 96,000 authors from 162 countries. The dispersion of studies followed an ascending distribution with a sharp increase in the second half of the 2000s. The evolution of keywords in terms of burst strength confirmed the advancements of technologies from primary first-generation to advanced fourth-generation bioenergies. Based on the evolution of science in this area, it is concluded that integrated sustainability assessment studies, covering technical, economical, environmental, and social aspects, are needed to bridge the gap between abundant theoretical endeavours and limited commercial use of this energy source.

Keywords: Biomass; Biofuel; Bioenergy; Scientometric; Sustainability

Nano Biotechnology

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This article deals with the extraction, recovery, and characterization of nano bio-hydroxyapatite particles (nBio-HAp) from pig bones obtained by hydrothermal alkaline treatment in combination with an ultrasonic wet milling process. Pig bone powder was defatted and deproteinized with an 1 N potassium hydroxide (KOH) aqueous solution for 24 h with stirring at 90 °C, followed by ultrasonic treatment pulsed at 100 W (Pulse-cycle: 70%) for 10, 20, 30, and 60 min. Fourier Transform Infrared spectroscopy (FT-IR) showed that the alkaline treatment removed the organic compounds from the mineral matrix. Dynamic Light Scattering (DLS) and Scanning Electron Microscopy (SEM) showed that the particle size decreased with increasing duration of ultrasound, indicating the mechanism of erosion and fragmentation of micro agglomerates into nanoparticles. The X-ray patterns showed that none of the methods used to clean and extract the nanoparticles (ultrasound) damaged the Bio-HAp nanocrystals. Full Width at Half Maximum (FWHM) and crystallite size proved that they have a size between 22 and 27 nm, which was confirmed by Transmission Electron Microscopy (TEM) in the form of platelets and bacilli. Inductively coupled plasma (ICP) showed the presence of Mg, Na, K, and Zn as minority ions and that the isolation processes of Bio-HAp nanoparticles do not affect their trace element concentrations.

Keywords: Bio-hydroxyapatite; Hydrothermal alkaline; Ultrasonication; Nanoparticles; Crystallite size

Kshitij RB Singh[a], Pooja Singh[b], Sadhucharan Mallick[c], Jay Singh[d], Shyam S. Pandey[a]. (a. Graduate School of Life Science and Systems Engineering, Kyushu Institute of Technology, 2-4 Hibikino, Wakamatsu, Kitakyushu 808-0196, Japan, b. Department of Biotechnology, Faculty of Science, Indira Gandhi National Tribal University, Amarkantak, Madhya Pradesh 484886, India, c. Department of Chemistry, Faculty of Science, Indira Gandhi National Tribal University, Amarkantak, Madhya Pradesh 484886, India, d. Department of Chemistry, Institute of Science, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India). **Chitosan stabilized copper iodide nanoparticles enabled nano-bio-engineered platform for efficient electrochemical biosensing of dopamine. International Journal of Biological Macromolecules, Volume 253, Part 8 (2023): 127587**

Neurodegenerative disorders are one of the significant challenges to the aging society, as per the United Nations, where 1 in 6 people globally over 65 years of age are expected to suffer by 2050. The exact pathophysiological root of these disorders is although not known adequately, but reduced dopamine (most significant neurotransmitters) levels have been reported in people affected by Parkinson's disease. Sensitive detection and effective monitoring of dopamine can help to diagnose these neurodegenerative disorders at a very early stage, which will help to properly treat these disorders and slow down their progression. Therefore, it is crucial to detect physiological and clinically acceptable amounts of dopamine with high sensitivity and selectivity in basic pathophysiology research, medication, and illness diagnosis. Here in this present investigation, nano-bio-engineered stable chitosan stabilized copper iodide nanoparticles (CS@CuI NPs) were synthesized to engineer the active biosensing platform for developing dopamine biosensors. Initially, the as-synthesized nano-bio-engineered CS@CuI NPs were subjected to its drop-casting onto an Indium tin oxide (ITO) conducting glass substrate. This substrate platform was then utilized to immobilize tyrosinase (Tyr) enzyme by drop-casting to fabricate Tyr/CS@CuI NPs/ITO bioelectrode for the ultrasensitive determination of dopamine. Several techniques were used to characterize the structural, optical, and morphological properties of the synthesized CS@CuI NPs and Tyr/CS@CuI NPs/ITO bioelectrode. Further, the as-prepared bioelectrode was evaluated for its suitability and electrocatalytic behaviour towards dopamine by cyclic voltammetry. A perusal of the electroanalytic results of the fabricated biosensor revealed that under the optimized experimental conditions, Tyr/CS@CuI NPs/ITO bioelectrode exhibits a very high electrochemical sensitivity of 11.64 μA μM−1 cm−2 towards dopamine with the low limit of detection and quantification of 0.02 and 0.386 μM, respectively. In addition, the fabricated bioelectrode was stable up to 46 days with only 4.82 % current loss, reusable till 20 scans, and it also performed effectively while real sample analysis. Therefore, the nano-bio-engineered biosensor platform being reported can determine deficient dopamine levels in a very selective and sensitive manner, which can help adequately manage neurodegenerative disorders, further slowing down the disease progression.

Keywords: Dopamine sensing; Electrochemistry; Neurotransmitter; Point-of-care applications; Nano-bio-engineered platform; Biosensors

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Amyloid-β (Aβ) fibrillation is a characteristic feature of Alzheimer's disease. Previous studies have identified several interfacial physicochemical factors, including charge, hydrophobicity, and chirality of multi-scaled biostructures, that determine Aβ fibrillation. However, the impact of ligand steric effects on the nano-bio structure in the Aβ fibrillation process remains unclear, which significantly hinders the development of highly efficient nano-inhibitors. Here we constructed four ligands (N-acetyl-L-cysteine (NAC), N-propionyl-L-cysteine (NPC), N-isobutyryl-L-cysteine (NIBC), and N-pivaloyl-L-cysteine (NPVC)) modified Cu2S quantum dots (QDs) with identical core-size (3.6 ± 0.6 nm) to investigate their respective ligand steric effects on Aβ40 fibrillation at nano-bio interface. Our results demonstrated that all four Cu2S QDs inhibited Aβ40 fibrillation in a dose-dependent manner, however, their inhibitory efficiency varied depending on the different steric structures of the ligands employed. NPC-Cu2S QDs exhibited the highest efficiency followed by NIBC-Cu2S QDs, NPVC-Cu2S QDs and NAC-Cu2S QDs at equivalent dosages. Mechanistic studies revealed that these differences in inhibitory efficiency were primarily attributed to the stereoselective interactions between the distinct steric ligands of Cu2S QDs and the electro-positive amino acid residues (R5, K16 and K28), as well as their neighboring residues within Aβ40 sequence. This work provides valuable insights into understanding the ligand steric effects of nano-inhibitors on Aβ fibrillation at nano-bio interfaces and offers guidance for precise regulation of protein fibrillation through customization of appropriate ligand groups.

Keywords: Steric effect; Aβ fibrillation; Nano-inhibitors

Sonia Vicente-Ruiz[a], Ana Armiñán[ab], Katia Maso[a], Elena Gallon[a], Oleksandr Zagorodko[a], Julie Movellan[ad], Fernanda Rodríguez-Otormín[a], Maike Baues[c], Jan-Niklas May[c], Federica De Lorenzi[c], Twan Lammers[c], María J. Vicent[ab.] (a. Polymer Therapeutics Laboratory, Prince Felipe Research Center (CIPF), 46012, Valencia, Spain, b. CIBERONC, Instituto de Salud Carlos III, 28029, Madrid, Spain, c. Department of Nanomedicine and Theranostics, Institute for Experimental Molecular Imaging (ExMI), RWTH Aachen University Clinic, Aachen, 52074, Germany, d. Current address: CIDETEC, Basque Research and Technology Alliance (BRTA), Parque Científico y Tecnológico de Gipuzkoa, Donostia-San Sebastián, Spain). Poly-l-glutamic acid modification modulates the bio-nano interface of a therapeutic anti-IGF-1R antibody in prostate cancer. Biomaterials, Volume 301 (2023): 122280

Modifying biological agents with polymers such as polyethylene glycol (PEG) has demonstrated clinical benefits; however, post-market surveillance of PEGylated derivatives has revealed PEG-associated toxicity issues, prompting the search for alternatives. We explore how conjugating a poly-l-glutamic acid (PGA) to an anti-insulin growth factor 1 receptor antibody (AVE1642) modulates the bio-nano interface and anti-tumor activity in preclinical prostate cancer models. Native and PGA-modified AVE1642 display similar anti-tumor activity in vitro; however, AVE1642 prompts IGF-1R internalization while PGA conjugation prompts higher affinity IGF-1R binding, thereby inhibiting IGF-1R internalization and altering cell trafficking. AVE1642 attenuates phosphoinositide 3-kinase signaling, while PGA-AVE1642 inhibits phosphoinositide 3-kinase and mitogen-activated protein kinase signaling. PGA conjugation also enhances AVE1642's anti-tumor activity in an orthotopic prostate cancer mouse model, while PGA-AVE1642 induces more significant suppression of cancer cell proliferation/angiogenesis than AVE1642. These findings demonstrate that PGA conjugation modulates an antibody's bio-nano interface, mechanism of action, and therapeutic activity.

Keywords: Polypeptide-based therapeutics; Immunoconjugate; Humanized monoclonal antibody; Prostate cancer; Tumor microenvironment

Biomimicry

Musen Chen[ab], Qian Wang[ab], Maxim Trubyanov[ab], Kou Yang[ab], Aleksandr S. Aglikov[c], Ge Qi[ad], Ekaterina V. Skorb[c], Kostya S. Novoselov[ab], Daria V. Andreeva[ab]. (a. Institute for Functional Intelligent Materials, National University of Singapore, 117544, Singapore, b. Department of Materials Science and Engineering, National University of Singapore, 117575, Singapore, c. Infochemistry Scientific Center, ITMO University, Lomonosova St., 9, Saint-Petersburg 191002, Russia, d. Chongqing 2D Materials Institute, Liangjiang New Area, Chongqing 400714, China). Large-Scale Self-Assembly of anisotropic graphene oxide films via blade Coating: Sustainable design and Stimuli-Responsive performance for biomimicry. Materials & Design, Volume 233 (2023): 112205

Sustainable structural design, utilizing material to imitate natural biological systems, presents both promise and challenges. By avoiding interfacial problems encountered in composite counterparts, such designs offer self-adaptive materials for smart housing and green architecture, etc. In this study, we demonstrate the feasibility of large-scale self-assembly of graphene oxide (GO) flakes into anisotropic films through a simple blade coating technique. Through the application of blade coating to a highly concentrated nematic GO suspension, we successfully fabricate GO films with morphological gradient and patterning. Additionally, we propose a statistical analysis method utilizing scanning electron microscopy (SEM) images for the characterization of materials with macroscopic surface morphology. Furthermore, we explore the application of these GO films as low-dimensional soft actuators, revealing their outstanding stimuli-responsive performance and self-adaptation to environment. Such robust and flexible films can be used as integral building elements in the bioinspired design of sustainable smart housing facilitating remote robotization and sensing capabilities.

Keywords: Graphene oxide; Large-scale films; Shear bands; Anisotropic mechanical properties; Self-assembly; Stimuli responsive; Blade coating

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
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62. Indian Agriculturist
63. Indian Biologist
64. Indian Farming
65. Indian Journal of Agricultural Science
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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
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82. Journal of Hazardous Materials
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85. Journal of Indian Soil Science
86. Journal of Industrial Microbiology & Biotechnology
87. Journal of Scientific and Industrial Research
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96. Perspectives-in-Biotechnology
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