

6th German-Brazilian Dialogue on Science, Research and Innovation

Introduction: Bioeconomy Strategies & Policies

- *German Bioeconomy Strategy*: Andrea Noske (Head of the Bio-Economy Division of the German Ministry of Education and Research - BMBF)



Andrea Noske was appointed Head of Division “Bio-Economy” at the German Federal Ministry of Education and Research in September 2015. Her main responsibilities include project funding as well as science and technology policy in relation to a bio-based economy.

Andrea Noske started her career as a Desk Officer at Project Management Jülich. In 1991, she joined the Federal Ministry of Education and Research (BMBF) in its “Laser Research and Technology” division. In 1996, she was appointed Desk Officer for Scientific Cooperation with Israel. In 1998, she served as Deputy Personal Assistant to Federal Minister Jürgen Rüttgers. In the following year, she assumed the position of Director for Infrastructure Management and Academic Personnel at JacobsUniversity in Bremen during its period of founding, staying there until the end of 2003. After returning to the BMBF, she organized the “Year of Science 2005”. From 2006 to January 2010, she was Head of Division “Cabinet; Parliament” followed by Head of Division “Basic Policy Issues; Internationalization Strategy”. At that time she was also Head of the German Delegation at the OECD Science and Technology Policy Committee and also at the OECD Education Policy Committee. From September 2011 she was Head of the Science and Technology section at the German Embassy in Washington, D.C. Andrea Noske holds an MSc degree (Diplom-Ingenieur) in Metallurgical Sciences from RWTH Aachen University, Germany.

Presentation: The presentation is thought to give better insights into the German National Bioeconomy Strategy.

Vision

A natural cycle-oriented, sustainable bio-based economy that carries the promise of global food supplies that are both, ample and healthy, and of high quality products from renewable resources.

Strategic objectives

In international comparison, Germany aspires to become a dynamic research and innovation center for bio based products, energy, processes, and services.

With our research, we want to meet our responsibilities for global nutrition, as well for the protection of the climate, resources, and the environment.

Central aspects are:

- i.) A holistic view on the value chains starting from biomass production, via
- ii.) Biomass conversion and
- iii.) Valorization towards the customer.
- iv.) Systems analyses on sustainability are a second important feature

To implement the „vision“ of a Bioeconomy as a new way of running an economy, the Federal Government has put forward it's **National Research Strategy on Bioeconomy** in 2010. It marked the switch from a „technology-oriented“ funding to a „mission-orientated“ funding, which is focused on the finding of solutions for the grand societal challenges. It is a multi-meaning interdepartmental strategy, with BMBF having the lead.

In 2013, a federal Policy Strategy on Bioeconomy was set-up under the primary responsibility of the Federal Ministry of Food and Agriculture. The aim is to develop a coherent Bioeconomy policy for all ministries.

The implementation of Bioeconomy is supported by a scientific council. The Bioeconomy Council provides information and advice to the Federal Government, supports the societal dialogue and gives recommendations for scientific funding. In 2015, they organized the 1stGlobal Bioeconomy Summit (GBS 2015). The 2ndGBS will take place in Berlin in April 2018.

• *Brazilian Action Plan on Science, Technology and Innovation on Bioeconomy*):
Bruno Nunes (General Coordinator of Bioeconomics of the Brazilian Ministry of Science, Technology, Innovation and Communications - MCTIC)

Bruno Nunes is Animal Scientist and Master Science in Animal Quality and Production from the USP. Previously worked with rural organization, technical assistance and agricultural production by the Secretariat of Agriculture and Supply of the State of São Paulo (SAA/SP). At MCTIC, he works on the topics of bioeconomics, having worked closely with the National Council for the Control of Animal Experimentation (CONCEA) and the National Technical Commission for Biosafety (CTNBio). Currently he is the General-Coordinator of Bioeconomy.

Brazilian Strategies and Policies for the Development of the Bioeconomy

The speaker will focus on the main Brazilian advances to consolidate strategies and policies in bioeconomics. Some of these initiatives are the National Program for the Production and Use of Biodiesel (PNPB), the National Plan for the Issuance of Low Carbon in Agriculture (Plano ABC), the RenovaBio 2030, the creation of the General Coordination of Bioeconomics and other initiatives for the development of Brazilian bioeconomics. In addition, the preparation of the Action Plan on Science, Technology and Innovation in Bioeconomics will be highlighted.

Keynote Speeches

- Georg Backhaus (Director of Julius Kühn Institute, Federal Research Institute for Cultivated Plants)



Dr. Georg F. Backhaus, President and Professor of the “Julius Kuehn Institute - German Federal Research Centre for Cultivated Plants” since 2008, is a Member of the Bioeconomy Council of the German Government, Chairman of the Scientific Board of the Leibniz-Institute for Vegetable and Ornamental Crops, Vice-Chairman of the Scientific Board of the German Society of Horticulture 1822, Member of the Scientific Council of the German National Action Plan on Sustainable Use of Plant Protection Products, Member of the Scientific Board of the German Association of Plant Breeders, and a Member of the German Agency on Renewable Resources. Before his current position, from 2002-2007, Prof.

Dr. Backhaus was President of the Federal Biological Research Centre for Agriculture and Forestry, a progenitor of the Julius Kuehn Institute.

Prof. Dr. Backhaus was awarded Diploma Degree in Agricultural Sciences at the University of Hannover in Germany in 1980, Research assistant and PhD student at the Institute of Plant Diseases and Plant Protection at the University of Hannover/Germany from 1980-1984, and PhD Degree in Horticultural Sciences (Dr. rer. hort.) in 1984. After completing his postdoctoral research at the Department of Forest Mycology and Pathology at the Swedish University of Agricultural Sciences in Uppsala, Prof. Dr. Backhaus attended the Preparatory Service required for entry into higher ranks of the German Plant Protection Services at the Governmental Plant Protection Agency in Rhineland-Palatinate in 1986. Subsequently, Prof. Dr. Backhaus was recruited as Head of the Unit „Plant Protection in Horticulture“ at the Chamber of Agriculture in Oldenburg/Germany before being appointed Head of the Research Institute for „Plant Protection in Horticulture“ of the Federal Biological Research Centre for Agriculture and Forestry, Braunschweig/Germany in 1993 (until 2002).

Presentation: Bioeconomy – a driving force for research at the German Federal Research Centre for Cultivated Plants

The Julius Kuehn Institute (JKI), Federal Research Centre for Cultivated Plants, carries out research with the major task to advise the German government in all issues concerning agriculturally relevant plants. Here, selected research projects with strong relation to bioeconomy will be addressed including breeding and crop management approaches for optimization of Russian dandelion as additional source for natural rubber, as well as the investigation of beneficial organisms for natural control of pests and diseases as a strategy to enhance biobased plant protection strategies. Moreover, the analysis of the composition of microorganisms in agrarian soils to improve the understanding of soil health as key component for sustainable growth and production of bioeconomically relevant plants is presented, and new insights are given on the qualitative improvement of cocoa and the possible use of organic waste from cocoa as alternative phosphorous fertilizer.

- Paulo Arruda (Principal Investigator. Scientist Laboratory of Regulation Study in Genic Expression Center for Molecular Biology and Genetic Engineering at the University of Campinas - UNICAMP-SGC)



Paulo Arruda is Professor of the Department of Genetics at the Institute of Biology, State University of Campinas. He received his Ph.D. in Genetics from the State University of Campinas and has pioneered the area of plant molecular biology and plant genomics in Brazil. His research interests are directed towards understanding the regulation of gene expression and its impact on amino acid metabolism and stress response. Professor Arruda is a member of the Brazilian Academy of Sciences, The World Academy of Science (TWAS) and The National Order of Scientific Merit of the Brazilian Republic Government. He has received Scientific and Technological Merit

Award from the Government of State of São Paulo, Brazil for the sequencing of the complete genome of the plant pathogenic bacteria *Xylella fastidiosa*. Professor Arruda was co-founder and Scientific Director of the plant biotechnology company Alellyx Applied Genomics. Currently, he is heading, in partnership with Structural Genomics Consortium (SGC) the creation of the Kinase Chemical Biology Center for Drug Discovery through open-access research and the Embrapa/UNICAMP joint Institute of genomics for climate change.

Presentation: Health and food: Genomics science towards the development of new drugs and stress tolerant plants

Genomics has revolutionized life sciences by making available the complete genome sequence of thousands of eukaryote and prokaryote organisms and an unprecedented array of tools that facilitate researchers to go from the gene to the phenotype. These standard tools can be used to investigate the biology animals, plant and microorganisms and make it possible to conduct comparative biology at large scale. Here, I will highlight the outcomes of two genomics initiatives from University of Campinas (UNICAMP) in the area of human and plant science. The first is the building of a hub of the Structural Genome Consortium (SGC) a Public Private Partnership focused on drug discovery using an open science model. The second is a partnership between UNICAMP and EMBRAPA concentrated in a gene discovery program to develop drought-tolerant crops. Both initiatives use the same Omics tools, and cross-talking between researchers and students between the two groups is sought to increase the knowledge and scientific outcomes synergistically. In the presentation, I will discuss examples of human and plant kinases and how the advanced knowledge on human kinases for drug development can be used to investigate plant response to drought stress. The goals of the two initiative are to help develop new drugs for the aging society and drought tolerant plants to face the threat of agricultural production and food security in the era of climate change.

Panel 1: Sustainable Food Production & Bioproducts

Session 1.1A - Theme: Bioeconomy and Food Security with Focus on Plants

Moderator: Peter Eisner



Dr. Peter Eisner earned his Diploma degree in process engineering in 1991 and his Ph.D. degree in 1997, both at Technical University Munich, Germany. He is lecturer at the TUM School of Life Sciences Weihenstephan, Freising, Germany, where he finished his habilitation thesis in the area of plant based food ingredients in 2014. At Fraunhofer Institute for process engineering and packaging, Freising, he is the deputy director and heads the department food process development. He is founder and former CEO of Prolupin GmbH, a Fraunhofer-spin-off-company that is successfully producing food ingredients and dairy substitutes based on lupin seeds.

Peter Eisner is alumnus and former speaker of Fraunhofer Vintage Class, an interdisciplinary group of 18 selected scientists and executives from Fraunhofer. He has published many research papers and technical papers and more than 45 patent applications. In the recent years he was responsible for several product launches of new developed food products and for the founding of 5 companies. On November 19th 2014 Stephanie Mittermaier, Katrin Petersen and Peter Eisner have been awarded with the Federal German President's Award for Innovation in Science and Technology "Deutscher Zukunftspreis" for their development and exploitation of new food ingredients with optimized functionality and taste based on lupins.

- Lázaro Eustáquio Peres (Assistant Professor of Plant Physiology at the Laboratory of hormonal control of plant development of the University of São Paulo, USP)



Lázaro Eustáquio Pereira Peres is an Associate Professor of Plant Physiology at the University of São Paulo (USP), Brazil, where he also received his PhD. His main research interest is plant development and its interaction with the environment, using tomato as a model. Among the mechanisms of plant development, his lab focuses on the intriguing capacity of plants to form organs (shoots and roots) during their life cycle, which are controlled by genes of organogenetic competence. He is also engaged in understanding the development of glandular trichomes, leaf structures that produce many defense-related compounds of economic interest. The adventitious formation of shoot and roots and the buildup of chemical defenses are typical responses of sessile organisms to the changing environment. The main environmental clues studied in Dr. Peres's Lab are drought and salinity stresses, as well as herbivory by arthropods. He has established and curates a large collection of induced mutants, natural genetic variation and transgenic plants in the model system tomato cv. Micro-Tom, which are being used worldwide for the study of physiological mechanisms and the genes

behind them. Some of the genes studied in the Dr. Peres's lab have alleles that were selected (or excluded) during tomato domestication and thus are important resources for crop improvement.

Presentation: *De novo* domestication of wild plant species

Ten thousand years of agriculture led to reduced genetic variation in most domesticated plants and animals. In crop plants, such 'genetic erosion' resulted in the loss of potentially useful traits, namely resilience in the face of climate change, resistance to adverse environmental conditions and reduced nutritional quality. Transferring those traits from wild species to their domesticated relatives is problematic due to their complex and multigenic genetic basis. Here, we present a proof-of-concept for the reverse approach, namely, improvement of the agronomic quality of the wild species *Solanum pimpinellifolium*, a relative of tomato (*S. lycopersicum*), using CRISPR/Cas9 multiplex genome editing. Genome editing techniques can thus be used to harness valuable genetic diversity available in wild species and to create novel crops with desirable traits absent in the cultivated species or lost during domestication. This *de novo* molecular domestication approach could produce crops suited for marginal areas, with increased nutritional value, and ultimately lead to increased food security, a pressing issue in the face of climate change and a growing world population.

- Jörg Kudla (Professor at the Institute of Plant Biology and Biotechnology of the University of Münster - WWU)



Academic Qualifications

1989 Diploma in Biology (grade: excellent), Diploma title: "Molecular genetic characterization of the plastid DNA of the genus *Antirrhinum*", Martin-Luther University Halle, advisor: Prof. R. Hagemann

1992 Ph.D. in Genetics (grade: summa cum laude), Dissertation title "Molecular genetic characterization and sequence analysis of the plastid DNA of *Antirrhinum majus*

L., Martin-Luther University Halle, advisor: Prof. R. Hagemann

2002 Habilitation in Genetics and Botany, University Ulm

Employment

1993 - 1994 Postdoctoral fellow in the Laboratory of Prof. H. Kössel, University Freiburg

1994 - 1997 Postdoctoral fellow in the Laboratory of Prof. W. Gruissem, UC Berkeley

1997 - 2003 Independent Group leader at the Department of Botany, University Ulm

2003 Full Professor (C3) for "Molecular Developmental Biology of Plants" at the University Münster

2010 Offer, Professorship as Chair of Biosciences, University of Birmingham, declined

Since 03/2011, Full Professor (W3) for "Molecular Genetics and Cell biology of Plants" at the University Münster

Since 09/2011 - 2014 Adjunct Professor for Plant Biology, China Agricultural University (CAU), Beijing 10/2013 Offer, Professorship (W3) "Plant Cell Biology and Biotechnology" within the Cluster of Excellence "CEPLAS", University of Düsseldorf, declined

Since 01/2015, Changjiang Scholar Chair Professor, China Agricultural University (CAU), Beijing

2008 –2017 Coordinator and Speaker Research Unit FOR964 "Calcium signaling via protein phosphorylation in plant model cell types during environmental stress adaptation"

Presentation: Approaches to enhance salt stress tolerance and nutritional value of tomato

Stabilizing yields of crops against adverse environmental cues and enhancing their nutritional value represent central aims of plant biotechnology worldwide. In particular for tomato (*Solanum lycopersicum*), salinization diminishes yields and results in dramatic economic damages. I will present and discuss results and perspectives of two complementary approaches to characterize and enhance tomato salt stress tolerance, which we currently pursue in collaboration with our Brazilian partners. Moreover, I will report on a successful proof-of-concept approach to use biodiversity-based smart breeding to generate a high-antioxidant containing tomato as nutritionally improved and potentially health enhancing bio product.

Session 1.1B - Theme: Bioeconomy and Food Security with Focus on Animals

Moderator: Luis Madi, President of Food Technology Institute (ITAL)

- Fernando Flores Cardoso (Researcher at Embrapa South Livestock)



Graduated in Veterinary Medicine from the Universidade Federal de Pelotas (1995), has a master's degree in Animal Science from the Universidade Federal de Pelotas (1999), master's degree in Applied Statistics from Michigan State University (2002), Ph.D. in Animal Science from Michigan State University (2003) and postdoctoral in Bioinformatics with emphasis on Statistical Genomics at Michigan State University (2006). Currently a researcher and deputy manager for research, development and innovation at the Brazilian Agricultural Research Corporation, Embrapa South Livestock Center (Bage/RS), and permanent faculty of the Graduate Program in Animal Science at Federal University of Pelotas and Applied Computer Science at Unipampa. Research fellow of the National Counsel of Technological and Scientific Development. He has experience in Animal Science with an emphasis in Animal Breeding and Genetics, acting on the following topics: breeding objectives and selection criteria, methodology for genetic evaluation of beef cattle, crossbreeding systems, use of genomic information in animal breeding and genotype-environment interaction.

Presentation: Development of genomic tools to select for economic and adaptation traits in taurine cattle breeds

Tropical areas in developing countries have great potential to help supply increasing demands for livestock products, as cattle and other ruminants have the ability to convert fast-growing tropical grasses into high-quality protein for

human consumption. Nevertheless, sustainability of beef production systems requires the use of livestock that are both highly productive and adapted to tropical environments. In this talk I will describe work underway in Brazil applying genomic tools to enhance beef cattle productivity and tropical adaptation, combining phenotypes related to parasite resistance, heat tolerance, growth and reproduction with medium density SNP markers.

- Klaus Wimmers (Head of Leibniz Institute for Farm Animal Biology - FBN)



Klaus Wimmers is Director of the Leibniz Institute for Farm Animal Biology (FBN), Dummerstorf, Germany, and Professor of Animal Breeding and Husbandry at the University of Rostock, Germany. He joined the Leibniz Institute in 2004 as head of the department of Molecular Biology and has been its Director since 2015. He obtained a degree in Veterinary Sciences from the Freie Universität Berlin in 1989, earned his doctorate at the Humboldt Universität zu Berlin in 1996 (Dr. rer. nat.) and habilitated in 2002 at the Rheinische Friedrich-Wilhelms-Universität Bonn in animal breeding and genetics. His main fields of interest are physiological,

genetic and epigenetic principles of expression and differentiation of traits related to animal welfare and resource efficiency in farm animals.

Presentation: Challenges and conflicting goals in sustainable livestock farming

Livestock farming is a central component of agricultural cycles and the bioeconomy and accounts for more than 50% of the production value from agriculture. Livestock farming faces a number of challenges in terms of its contribution to food security and safety, animal welfare, biodiversity, resource efficiency and climate change as well as new opportunities such as the development of genomic selection, genome editing and digitization. A comprehensive understanding of the physiological and ethological needs of farm animals and their performance is necessary to make livestock farming in a diversified, site-adapted, sensor- and biomarker-based agriculture resource-efficient and animal-friendly and to ensure the production of healthy food of animal origin.

Session 1.2 - Theme: Integrated Landuse Systems

- Manuel Macedo (Researcher at Embrapa Beef Cattle Center)



Holds a degree in Agronomy from the Luiz de Queiroz College of Agriculture (ESALQ), University of São Paulo (1972), a Master of Science in Soil and Plant Nutrition from the ESALQ, University of São Paulo (1976) and a PhD in Soil Science from North Carolina State University (1983), at Raleigh, USA. He is a scientific senior researcher at the Brazilian Agricultural Research Corporation - EMBRAPA, at Embrapa Beef Cattle National Center, since 1983. He was a guest professor of postgraduate course in Agricultural Production, University of the MS State for Development of the Pantanal Region. Advisor and co-supervisor of master's dissertations and doctoral theses in some Brazilian Universities. He has experience in

the field of Agronomy, with emphasis on Soil Fertility and Plant Nutrition, and Soil Management, working mainly on the following topics: fertilization, plant nutrition and recovery of degraded pastures, integration of crop-livestock systems. He is coordinator of research activities in several projects of EMBRAPA and former member of joint projects with international Institutions from Japan, Scotland, Germany and USA. Actually is coordinator of the Soil and Plant Nutrition Laboratory at the Beef Cattle National, Campo Grande, MS, Brazil.

Presentation: ICLS and ICLFS: an approach to improve sustainability and land use in Brazil

The impact of land use change from native vegetation to pastureland and cropping along the last 30 years drove many areas to pasture and soil degradation. Continuous pasture and cropping, inadequate animal management, lack of crop rotation, excess of soil preparation are some causes of the process. Land use mismanagement accelerated deforestation and searching to open new areas. Integrated crop/livestock and crop/livestock/forest systems (ICLS/ICLFS) is a Brazilian approach to improve sustainability and minimize GHG emissions. As consequence, productivity, lesser environment impacts, and better land use and labor efficiency became a real possibility with these proposed production systems in Brazil.

- Wolfgang Weisser (Professor at the Chair of Restoration Ecology at the Department of Ecology and Ecosystem management, TUM)



He is an animal ecologist who studied biology and mathematics in Gießen and Bayreuth in Germany. In 1994 he received his D.Phil. from Oxford University, U.K. where he carried out research in Behavioural Ecology at the Department of Zoology. After Postdoc periods at Imperial College at Silwood Park and in the Zoology Institute, University of Basel, he moved to the Friedrich-Schiller-Universität Jena, Germany, in 1999, as professor

for Terrestrial Ecology. Since 2011 he holds the chair for Terrestrial Ecology at the Technische Universität München, Germany. In his fundamental research he is interested in the mechanisms underlying the relationships between land use, biodiversity and ecosystem functioning. In his applied research he aims at using science to improve the design of green infrastructure and conservation in general.

Presentation: Integrated land-use systems for multi-functional landscapes

Currently, most land is managed for a single use only, e.g. crops, forest, housing, or nature conservation. With increasing demands in most sectors, the available land area is not sufficient to satisfy all uses. Land use in the future needs to be multifunctional at the landscape scale, combining intelligently various land uses, e.g. agriculture and forestry, agriculture and nature conservation. This will increase the long-term per area output of ecosystem services, including production. In my talk I will illustrate this smart approach to land management with examples.

Session 1.3 - Theme: Bioproducts by Biodiversity

- Cristina Dislich Ropke (CEO at Phytobios)



Graduated in Pharmacy and Biochemistry with Master Degree, Doctorate and Post Doctorate in Pharmaceutical Sciences at the University of São Paulo. Expertise in intellectual property and partnering with Universities. Experience in setting up projects for public research financing and access to genetic resources for research and technological development. Published 16 papers in the dermatological and pharmaceutical areas, five of them, as first author. Is the inventor of five patent applications. Received 6 awards from the Brazilian Cosmetology Association and one

award for Best Paper 2009, Section of Dermatology of the SOT, published by Cutaneous and Ocular Toxicology. CEO at Phytobios, a Brazilian company focused on the development of technologies originating from Biodiversity, through research and innovation. International courses such as "Developing and Managing a Successful Technology and Product Strategy" and "Fundamentals of Finance for the Technical Executive" at MIT Sloan School of Management. Biodiversity Director at ABIFINA.

Presentation: BRAZILIAN BIODIVERSITY: New frontiers in Drug Discovery

The environment for drug discovery and development has been facing some major challenges, such as pharmaceutical industry pipelines that are insufficient to replace revenues from drugs that are becoming generic, increasing criticism of university technology licensing practices and high attrition rates in early stage research. To overcome these challenges, there is a reconfiguration of the pharmaceutical value chain coming in place, mainly creating novel business models for Drug Discovery. This will provide an opportunity for biotech startups and research-based pharma companies to develop full-scale discover molecules powerhouses. This kind of companies will be more efficient, since they suffer less from strategic attrition and the new drug candidates can be systematically tested across different therapeutic areas.

Recently, natural products have re-emerged as one of the solutions to fill the innovation gap in early drug discovery, which has proven challenging for previous organizational models. Looking ahead, recent technological advances could be sufficient to revitalize the value of natural products as starting points for drug discovery, particularly with the recent growing interest in phenotypic screening.

A multidisciplinary approach to drug discovery, involving the generation of truly novel molecular diversity from natural product sources, combined with total and combinatorial synthetic methodologies, and including the manipulation of biosynthetic pathways provides a new solution to the current global productivity crisis regarding new chemical entities for several diseases. Brazil is home to one of the richest biodiversities in the world, and in the last 10 years, massive governmental investments have been made to provide state-of-the-art research capabilities for Drug Discovery in the country.

Another very positive aspect, is that the legal framework in Brazil, for access to genetic resources and benefit sharing has been strengthened. As disclosed by the Brazilian Ministry of Environment, the Law No. 13,123/2015 refers to a new model for the development of research carried out using Brazilian biodiversity. The law brings innovations that intend to

simplify and accelerate all procedures related to access to genetic resources or associated traditional knowledge. From a global perspective, it is important to create an open discussion that takes into consideration diverse points of view. In different countries industries, researchers, local groups with knowledge of natural resources and government actors, struggle to develop a balancing act that benefits each of these parts. Brazil is taking important steps towards the creation of an open discussion environment in a legal certainty scenario. The legal access to genetic resources can address health needs and domestic economic development simultaneously.

Therefore, all these aspects turn Brazil into an important player in modern drug discovery based on biodiversity.

- Ludger Wessjohann (Head of Bioorganic Chemistry Department at Leibniz Institute for Plant Biochemistry - IPB)



Professor Wessjohann studied chemistry in Hamburg (Germany), Southampton (UK), and Oslo (Norway, Prof. Skattebøl). He earned his doctorate in 1990 with Prof. de Meijere in Hamburg. After a short period as lecturer in Brazil, he became a postdoctoral Feodor-Lynen fellow of the Alexander von Humboldt foundation with Prof. Paul Wender at Stanford University (USA) working on the total synthesis of Taxol[®]. After an assistant professorship in Munich (LMU, 1992-1998) he was appointed to the Chair of Bioorganic Chemistry at the Vrije Universiteit Amsterdam (NL), working on organometallic chemistry and biocatalysis.

Since 2001 he is director of the dept. of bioorganic chemistry at the Leibniz Institute of Plant Biochemistry (IPB) in Halle (Germany), and in parallel holds the chair of natural product chemistry of the Martin Luther-University Halle-Wittenberg. 2010 - 2017 he was Managing Director of the IPB (www.ipb-halle.de).

Prof. Wessjohann focuses on the discovery, synthesis and application of natural products and derivatives. He has over 350 publications, 30 patent applications, and is co-founder of six companies. He is member of many boards and commissions, and received several scholarships, prizes and honors, e.g. Microsoft IT Founders Award, honorary membership of the Argentinean Soc. of Synth. Org. Chem. He is a foreign member of the Brazilian Academy of Science. He is speaker of the "Science Campus Plant Based Bioeconomy" in Halle (over 2000 researchers in plant and related sciences) and of the Leibniz Research Alliance "Bioactive Compounds and Biotechnology".

Presentation: Examples of Basic and Applied Research on High Value Products from Plants

Plants are the basis of all life and the central column of any bioeconomy. We depend on plants for oxygen, food, feed, fibre and wood but also as raw materials and renewable resource for basic to advanced materials and chemicals in pharmaceutical, cosmetics, F&F and chemical industries. To achieve the bioeconomy goals set forth by the German bioeconomy council, future plant-based production systems require improved varieties of plants with better adaptation to environmental conditions and cultivation and higher yields while reducing the resource requirements. Especially important for a country like Germany with high cost (salaries!) and a lack of agricultural area is access to frontier technologies to produce high value products from its biological resources. Therefore the ScienceCampus Halle "Plant-Based

Bioeconomy – from molecule to society” concentrates on improved primary production of plant products and their conversion to value-added products, and in addition looks at the socio-economic consequences and perspectives of bioeconomy. Life cycle end uses without significant profit margins like plants for energy production are not a focus of our research.

After an introduction to the ScienceCampus Plant-Based Bioeconomy we will present a few selected examples from our research, e.g. turning citrus waste into high value flavor products

Films to watch:

<https://www.youtube.com/watch?v=ejm-Y->

[u9BW4](#)

<http://www.beilstein.tv/typost/taste-modifiers-virtual-screening-and-biocatalytic-production-with-rationally-optimized-enzymes/>

Panel 2: Technical Application of Biomass and Bioenergy

Moderator: Marie Anne van Sluys (Assistant of the Coordination Life Sciences and Coordination of the program BIOEN, FAPESP)

Session 2.1 - Theme: Biomass Technologies and Biorefineries

- Mario Tyago Murakami (Principal Investigator in the Mechanistic & Structural Biology Group at CTBE-CNPEM)



Mario Murakami is Principal Investigator at CNPEM since 2008 and was the coordinator of the X-ray Crystallography Facilities from 2008 to 2016. Currently, he is the coordinator of the Molecular Division at CTBE/CNPEM. Murakami is graduated in Engineering at UNESP with PhD on Molecular Biophysics with sandwich period at University of Hamburg. He did postdocs in Macromolecular Crystallography and Biomolecular NMR at UNESP and Rutgers University, respectively. In 2013, he received his “Habilitation” (Dr rer. Nat. habil.) from UNICAMP. He has experience in enzyme structure, function and engineering, and his current research is associated with Glycobiology and Applied Glycosciences.

Presentation: Biotechnological Routes Under Development at CTBE/CNPEM for Biomass Utilization in the BioEconomy

The Brazilian Bioethanol Science and Technology Laboratory (CTBE) is one of the four National Laboratories held at the National Center for Research in Energy and Materials (CNPEM) and has as its main mission to integrate basic science with the productive sector, not only in Bioenergy field but also in related areas covered by the Bioeconomy. Several technologies, identified as bottlenecks for biofuels industry, are being developed in partnership with companies such as an enzyme cocktail customized for saccharification of Brazilian biomasses, a C5-fermenting yeast, and a biochemical route for biodiesel and biokerosene production. In this seminar, the status of such technologies will be presented.

- Jürgen Kern (Senior scientist at the Bioengineering Department at Leibniz Institute for Agricultural Engineering and Bioeconomy -ATB)



1990 Study on the biological monitoring of organic pollutants in aquatic systems at the Fraunhofer Institut für Umweltchemie und Ökotoxikologie, Schmallenberg

1991-1995 Research Studies on the nitrogen cycle in Amazonian floodplains at the Max-Planck Institute of Limnology in Plön and the INPA in Manaus (Brasil)

1994-today Researcher at the Leibniz-Institute for Agricultural Engineering, Dep. Bioengineering

1996 -2002 Interdisciplinary project: „Approaches for a sustainable agricultural production – Model region Northeast Germany“ (GRANO). Management of the subproject: „Reuse of biosolids in agriculture“

1997 -2002 Interdisciplinary project in cooperation with the Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus/Brazil: „Stressphysiology, primary production und dynamics of Amazonian forests-SHIFT“. Management of the subproject: „Nitrogen turnover in forest ecosystems“

2004 -2007 Participation within the EU COST action 856 “Ecological Aspects of Denitrification, with Emphasis on Agriculture”

2004 -2007 Editor-in-chief of the journal Agricultural Engineering Research

2007 -2009 Cooperation with University Rostock: „Utilization of biomass ashes for the phosphorus supply in plant production“; Funding: Fachagentur für nachwachsende Rohstoffe (FNR)

2008 -2012 Project on „Influence of mineral nitrogen fertilization on crop yield of poplar and willow and environmental effects“; Funding: Fachagentur für nachwachsende Rohstoffe (FNR)

2011 -2014 Program coordinator at ATB for the research program: Material and energetic use of biomass.

2011-2014 Interdisciplinary project: „Development of sustainable land use systems (ELaN)“. Management of the subproject: “Nutrient recycling“

2012-2015 International Network project “Biochar in Agriculture –Perspectives for Germany and Malaysia”

2012-2016 Management of EU COST Action TD 1107“Biochar as option for sustainable resource management”

2012-2014 Study on “Chances and risks of biochar applied to soils “ for the German Federal Environmental Agency (UBA)

2013-2016 EU project: “Branching out European Energy Resources Into the Improvement of Agricultural Prunings Logistics (EuroPruning)”. Management of the subproject “Soil management”

2015 -2017 DFG-FAPERJ project “Modification of soil organic matter by thermochemical conversion of biomass according to ancient soil horizons –Innovative strategy for soil management. International collaboration between Brazil and Germany

2017 -2020 EU project within the Research and Innovation Framework Programme (Horizon 2020): “Facilitating market roll-out of RESfuels in the transport sector to 2030 and beyond (AdvanceFuel)”. Management of the working package “Improved lignocellulosic feedstock supply chains for advanced liquid biofuels”

Presentation: Closing the loop between biomass residues and plant production

The use of biomass gains in importance since fossil raw materials are progressively being depleted and the global climate is seriously changing. This is the driving force to build up a bio-based economy including the whole biomass value chain from its production, processing and finally its chemical and thermal conversion to products, such as lactic acid, biogas and biochar. New biorefinery concepts may integrate substantially closed material and energy fluxes by the recycling of organic residues and the recovery of nutrients and carbon for soil application. This is one way to maintain the humic matter and the fertility of soil, which is both the most important factor of agricultural production and also a considerable carbon sink.

Session 2.2 - Theme: Renewable Chemistry

- Paulo Luiz de Andrade Coutinho (Manager of the SENAI Institute of Innovation for Biosynthetics)



Chemical Engineer with a Master’s Degree in Chemical Processes from COPPE/UFRJ’s Chemical Engineering Program (1982) and a Doctorate in Innovation Management from the School of Chemistry/UFRJ (2004). He worked between 1983 and 2008 as a process engineer, researcher, Area Coordinator and Technical Manager at Petroflex Industria e Comercio SA while participating / been responsible for the development of various processes / products in elastomers area, some with

patents in the country and abroad. In September 2008 he took over as Open Innovation Manager at Braskem SA, the largest resin producer in the Americas. He was responsible for the management of the BRASKEM’s network with the Academy, research centers and R&D development agencies in the country. From 2010 until 2015 he was the Prospecting and Evaluation Manager in Renewables, being responsible for monitoring, identifying and evaluating opportunities in the renewables area. He conceived, developed and implemented BRASKEM’s CHEMICALS Roadmap from RENEWABLE RAW MATERIALS. He participated in the negotiations and the establishment of partnerships with Genomatica and AMYRIS in butadiene and isoprene from renewable raw materials. In January 2014 he also took over the areas of Knowledge Management and Intellectual Property of the company. In January 2016 He left BRASKEM to take the implementation of the Senai’s Biosynthetic Innovation Institute in Rio de Janeiro.

Presentation: The Challenges of Biomass-Based Chemistry

Much of the chemical industry today has petroleum as the basic raw material. The transition or even significant participation of biomass in this context involves the development of products that are competitive with existing ones or that bring solutions to new problems. The use of biomass and / or its residues and the need for this competitiveness brings challenges that cannot be ignored: availability, logistics, scale, yields, competition with food (including land use), strategies, etc. In this sense, it is necessary to discuss elements that lead to the identification of products and activities that increase the chance of success of initiatives in this sector. From the example of products and companies it is demonstrated that only molecules

with high yield in the raw material have survived to the initial stage of insertion in the market. This is due to its potential for competitiveness in cost. They comprise new molecules, which requires a high effort in the development and demonstration of its application in the market. This also requires adequate strategy on the part of companies.

- Volker Sieber (Head of the Chair of Chemistry of Biogenic Resources at Technical University of Munich - TUM)



Prof. Sieber studied chemistry at the University of Bayreuth and the University of Delaware. After obtaining his doctorate, he went to the California Institute of Technology as a research fellow. Following a brief sojourn at McKinsey & Co., Prof. Sieber held a number of positions in the chemical industry between 2001 and 2008 (Degussa, Süd-Chemie). He has been a full professor at TUM since late 2008. In parallel, he is heading a Fraunhofer Institute branch in the area of bio-, chemo- and electrocatalysis, which he has built up over the last years. In 2015 he became one of the founding members of the council on Bioeconomy for the government of the Free State of Bavaria. Since 2017 Prof. Sieber is rector of the TUM Campus Straubing for Biotechnology and Sustainability.

Presentation: Chemo-enzymatic synthesis routes for the production of bio-based chemicals from sugar and waste residues

The utilization of biomass for the production of chemicals is a key element of a “greener” economy. The challenge in this, however, is twofold: The conversion process has to be more sustainable and the products have to be superior in performance and/or prize compared to their petrochemical pendants. By combining the best of both worlds – chemical catalysis and biocatalysis – and by utilizing functionalities brought along by the substrate molecules we develop new benign conversion routes.

For example, sugar was converted to diols and dicarboxylic acids by establishing non-natural enzymatic cascades built upon engineered enzymes. As another example, we have used the byproducts of cellulose production for the formation of new epoxides and polyamides. Due to the cyclic molecular character of the building blocks the new bio-based polymers showed superior properties like improved shock resistance and weight.

Session 2.3 - Theme: Bioenergy by Biodiversity

- Alessandra Alves de Souza (Researcher at the Center of Citriculture, Agronomic Institute of Campinas, IAC)



1992 B.Sc., Biology Sciences, Catholic University, Pernambuco, Brazil

1997 M.Sc. Microbiology, University of São Paulo (USP), São Paulo, Brazil

2004 Ph.D. Genetics and Molecular Biology, State University of Campinas (UNICAMP), São Paulo, Brazil - Thesis: Comparative analyses of the *Xylella fastidiosa* gene expression associated with pathogenicity and biofilm formation.

2009 Sabbatical, University of California, Berkeley, USA

2005 – present - Scientific Researcher, Biotechnology, Citrus Center – IAC, São Paulo, Brazil.

Presentation: Applied knowledge in Plant-Pathogen interaction aiming plant disease control

To feed a population of 9.7 billion by 2050, food production will need to increase from its current amount of 8.4 billion tons to almost 13.5 billion tons per year (FAO, 2017). Under this scenario, technological innovation has been indicated to be a driver to help agricultural production and to ensure food security. Additionally, crop losses due to pathogen attack are considered an important issue since it is necessary the use of large amounts of pesticides to maintain agricultural productivity; however, their use causes environmental damage and directly impacts agricultural sustainability. Thus, new technologies are needed to improve food crop yields and decrease the use of agrochemicals. Following this approaches we have been working on plant-pathogen interaction, specifically on citrus and bacterial pathogens, to find alternatives to impair the disease and discover new products to be used in the field. Among some strategies already in progress, we will point out the use of N-acetylcysteine (NAC) to control *Xylella fastidiosa* (a multi-host pathogen) and *Xanthomonas citri*, which cause citrus variegated chlorosis (CVC) and citrus canker (CC) disease in citrus, respectively. In our previous studies we have demonstrated that biofilm formation is important for pathogenicity of both bacteria, in a mechanism similar to bacteria that cause human diseases. Thus, looking for molecules used in medicine that could be applied in the field, which means low cost and environmental safety, we started working on NAC. This molecule is an analogue of cysteine that can disrupt disulphide bonds and has antioxidant and antimicrobial properties. We previously demonstrated that NAC can disrupt *X. fastidiosa* and *X. citri* biofilm in vitro and significantly decreases bacterial population and symptoms of CVC and CC in greenhouse condition. Thus, we tested the NAC effect in field condition in plants showing CVC. Two years of evaluation in plants showing severe CVC symptoms, revealed that application of NAC to the roots was able to improve the production and fruit size in both diseased and healthy plants, indicating that this molecule has also a beneficial effect to the plant. Thus we investigated the antioxidant property of NAC and confirmed that treated plants showed a reduction of reactive oxygen species and induction of antioxidant enzymes. These results showed the potential of NAC for *X. fastidiosa* control and also in decreasing oxidative stress in plants, so this approach has also been used in a collaborative international project X-FACTOR to try to control *X. fastidiosa* causing olive disease in Italy. Besides, the use of NAC in field condition has also been used to control CC disease. Nowadays the method used to control CC is using copper, which is a heavy metal compound toxic for the environment. Our previous data (one year in field) showed that NAC can be effectively used to decrease CC disease progress, reducing the use of copper in the field. Aiming to use NAC as an alternative to control bacterial disease in citrus, as well as in other hosts, it was recently approved a PIPE (Innovative research in small enterprises FAPESP program) and a FAPESP thematic project.

- Tim Schulzke, Group Manager Thermochemical Processes and Hydrocarbons at Fraunhofer Institute for Environmental, Safety and Energy Technology - UMSICHT



Tim Schulzke studied chemical engineering at University of Dortmund, where he received his diploma in 1992. From then on he works at Fraunhofer UMSICHT, since January 1st, 2013 as group manager “Thermochemical Processes and Hydrocarbons” in the department “Biorefinery & Biofuels”. In the field of thermochemical biomass conversion he authored 24 contributions to conference proceedings, 8 peer-reviewed journal articles and 1 book chapter.

Presentation: Fast Pyrolysis for the Conversion of Biomass Residues to Biofuels and Bioproducts

Biomass residues from forestry (branches, capping, thinning) and agriculture (straw, shells, bagasse) can be converted by fast pyrolysis into an intermediate liquid product – pyrolysis oil. Typically such bio-oils have undesirable properties like high water content, high acidity and hence corrosivity, low heating value and high oxygen content. Combined with low-effort upgrading steps like staged condensation and catalytic vapor upgrade the properties can greatly be enhanced and thus increase the applicability of condensates. Examples will be given for the application in polyurethane foams and phenol-formaldehyde resins as well as different fuel applications.