FAPESP BIOEN
Program Highlights

BBEST 2017 Edition

BIOEN

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Credits

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Table of Contents

PHOTOS ON FRONT AND BACK COVER, AND THIS PAGE (DETAIL ON THE LEFT): LÉO RAMOS CHAVES | *PESQUISA* FAPESP

Introduction

FAPESP BIOEN Program Highlights – BBEST 2017 Edition takes stock of the participation by researchers from the BIOEN Program in the Brazilian Bioenergy Science and Technology Conference (BBEST 2017).

The international conference BBEST 2017 was held from October 16th to 19th, 2017, in Campos do Jordão (SP, Brazil), and the conference's theme this year was "*Designing a Sustainable Bioeconomy*". It is increasingly important to promote the expansion of the economy through new opportunities enabling reductions in the emissions of greenhouse gases (GHG) and to encourage sustainable development in Brazil and worldwide.

This edition of Highlights also congratulates the winners of the BBEST Awards, a prize given for the best poster presentations at the conference by students at master's, doctoral and post-doctoral levels.

We hope you will enjoy reading this report!

CLAUDIO AROUCA

Plenary lecture – BBEST's Policy Day (October 17th, 2017).

The BIOEN Program involves more than 300 researchers and 453 students, within 24 fields of knowledge, receiving 763 research grants and scholarships in Brazil and around the world, and with over 1,100 articles published in indexed journals. This is the present balance of the FAPESP Bioenergy Research Program (BIOEN), a major investigation effort set up in 2008 bringing together researchers in several fields of knowledge from academic and industrial laboratories in order to promote and enhance the production of bioenergy in Brazil.

Source: BV-CDI FAPESP. Available at: <http://bv.fapesp.br/pt/16/pesquisa-em-bioenergia-bioen/> [Accessed 31 October 2017].

BIOEN was set up for three reasons, says FAPESP scientific director, Carlos Henrique de Brito Cruz. Firstly, because of the importance of bioenergy to the economy and the environment of the state of São Paulo and of Brazil as a whole; secondly, to meet the challenge of finding solutions for the commercial production of second- and third-generation sugarcane bioethanol, in parallel with increased first-generation ethanol production. And thirdly, in order to promote the research of Brazilian scientists within the international debate on bioenergy, particularly from the standpoint of sustainability. Worldwide concern for climate change has led to the integration of the program with initiatives to find alternatives to fossil fuels in order to reduce greenhouse gas emissions.

In the area of biomass, the program seeks enhanced efficiency in crop yields in order to bring down costs and reduce the amounts of land, inputs and water used in production — and consequentially, the environmental impacts. In addition to agronomy and plant breeding, the studies include the development of biotechnological tools (genome sequencing and genetically modified plants); good results have already been obtained in increasing sugarcane yields, saccharification and drought tolerance. These advances are important not only for boosting yields, but also because they pave the way for second-generation ethanol production.

In the development of biofuels, the research aims to improve first generation processes (those using fermentation of the sugarcane juice) in all their stages, and contribute to knowledge of the second generation processes that use lignocellulosic materials such as sugarcane bagasse, and the waste from agricultural and forestry activities in order to produce ethanol. These processes aim to boost the potential for ethanol production without increasing the area under sugarcane, in order to ensure sustainable ethanol production. Other studies seek to integrate first generation processes with second generation processes in order to produce electricity for export to the energy grid.

The network of scientists cooperating with the private sector is developing processes in the field of biorefineries in order to obtain high added value commodities (including medical, cosmetic and food applications) and thus

Source: BV-CDI FAPESP. Available at: <http://bv.fapesp.br/pt/16/pesquisa-em-bioenergia-bioen/> [Accessed 31 October 2017]. Infographic produced over photo from Léo Ramos Chaves | *Pesquisa* FAPESP.

LÉO RAMOS CHAVES | *PESQUISA FAPESP*

demonstrate the potential and the benefits inherent in projects in this field so as to develop the so-called bioeconomy in the state of São Paulo and in Brazil. Additionally, collaborative studies are seeking to develop new setups for the biofuel driven internal combustion engines, reducing consumption and gas emissions, and measuring their economic and environmental feasibility.

In the field of sustainability, the program seeks better to understand the environmental impact of sugarcane production, having demonstrated that sugarcane growing and the production of ethanol have beneficial effects on reductions of greenhouse gases and on carbon stocks in the soil. The studies also include the role of nitrogen fertilizers in nitrous oxide emissions from sugarcane plantations.

One indirect result of BIOEN's activities has been greater understanding of the international ethanol market. Analyses of the growth of sugarcane crops, the modeling of changes in the area under this crop, and changes in land use in Brazil have played an important role in influencing international dialog and demonstrating that Brazilian ethanol is an advanced biofuel. These studies have also contributed to the discussion of the public policies needed in order to expand the use of bioenergy worldwide. Researchers from BIOEN and those from two other FAPESP Programs (Biota and Climate Change) led the team of 137 researchers from 24 countries that brought out the *SCOPE Bioenergy & Sustainability* Report in 2015, summarizing pathways towards the sustainable expansion of bioenergy worldwide. More recently, members of the team met again to produce a new report addressing bioenergy sustainability with a specific focus on Latin American and African countries. It will be published in early 2018.

Brazilian Bioenergy Science and Technology Conference 2017

The BBEST conference is an international benchmark in bioenergy because in its three previous stagings (2011, 2014 and 2017), it brought together the most prominent Brazilian and international scientific researchers on the topic. The hill town of Campos do Jordão (SP) hosted the three meetings which enabled intense exchanges of know-how on the major innovations in the field of bioenergy and bioeconomy, as well as discussions concerning strategies to divulge such technologies worldwide.

BBEST Awards is the traditional prize given to the best poster presentations at the conference for Masters, doctoral and post-doctoral students (*see page 25*). Another highlight was the first staging of *the Global Biobased Business Competition* (G-BiB) challenge, a competition between masters and doctoral students promoted by BE-Basic, a Dutch institution supporting sustainable technologies, in collaboration with FAPESP (*see page 28*).

CLAUDIO AROUCA

Opening ceremony – BBEST 2017 (October 17th, 2017). From left to right: Heitor Cantarella, Luuk van der Wielen, Glaucia M. Souza, José Goldemberg, Carlos Henrique de Brito Cruz, and Marcio de Castro Silva Filho.

At the opening of BBEST 2017, José Goldemberg, President of FAPESP, stressed how strategic it is for Brazil to invest in research in bioenergy: "I am convinced that bioenergy will play a strategic role in the energy system over the next few decades. This conference is a great opportunity to shed light on technological problems and make bioenergy a sustainable source".

He pointed out that by 2050 bioenergy would account for almost 30% of all energy used worldwide — the current figure is approximately 10%, according to data from the International Energy Agency (IEA).

Under the auspices of BIOEN, researchers are developing new technologies to innovatively exploit biomass producing not only bioethanol, but also biofuels for aviation and biological byproducts that can replace petrochemicals and meet society's main demands for sustainability. Another speaker at the opening ceremony, Luuk van der Wielen, director of BE-Basic and co-chair of the conference itself, pointed out that the fossil-fuel-based economy "is no longer safe" and that bioindustry has an important role to play in this new context — not only in the future but also in the present, as well as being a pathway for Brazil to overcome its current economic difficulties. Also taking part in the opening ceremony were Glaucia Mendes Souza, chair of the BIOEN Program coordination committee and co-chair of the conference; Heitor Cantarella, researcher at Instituto Agronômico de Campinas (IAC) and Marcio de Castro Silva Filho, from Escola Superior de Agricultura Luiz de Queiroz (ESALQ-USP), both of whom are general secretaries of BBEST 2017, as well as Carlos Henrique de Brito Cruz, scientific director of FAPESP.

On the eve of the opening of the conference attendees were offered tutorials in the fields of entrepreneurship and business plan creation for the development of sustainable innovations; industrial production of biofuels; sugarcane and energy-cane; and sustainability in the use of water and land to produce bioenergy. More than 80 lectures and presentations of studies were held during the three days of BBEST 2017, covering important issues in bioeconomics, thus consolidating the conference's position as the major event spreading knowledge concerning Brazil's bioenergy, and one of the most important international events in this field.

CLAUDIO AROUCA

Poster session at BBEST 2017.

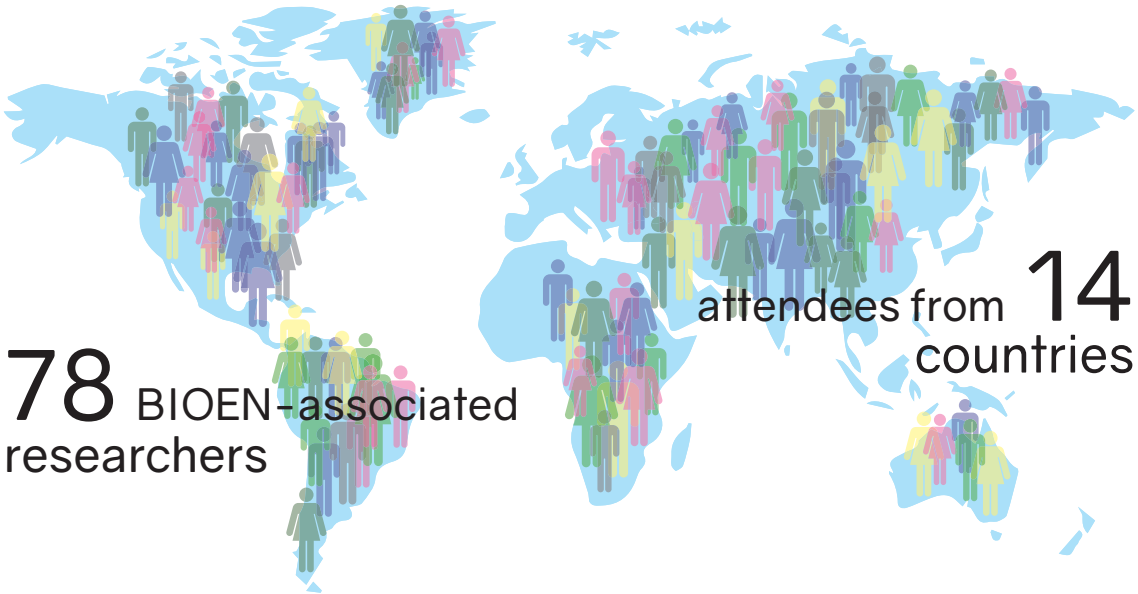
CLAUDIO AROUCA

Welcome sign at the entrance of the conference venue – BBEST 2017.

BIOEN at BBEST 2017

A word from the coordinators

One of the main goals of BBEST is to make recent scientific production by Brazilian researchers in the field of bioenergy more visible, thus encouraging a body of knowledge to underpin the change towards a renewable resource-based economy. According to Glaucia Mendes Souza, coordinator of the BIOEN Program, the conference brings together players from academia and



CLAUDIO AROUCA

Some members of BBEST's organizing committees. From left to right: Rafael Vasconcelos Ribeiro, Marcio de Castro Silva Filho, Luuk van der Wielen, Glaucia M. Souza, Heitor Cantarella, Luiziana F. da Silva, Flavia V. Winck, Antonio Bonomi, and Rubens Maciel Filho.

industry and strives to inform public policymakers of the most recent scientific and technological advances. "Previous events enabled us to provide a good sample of how bioenergy interacts within the *nexus* of food security, climate security, environmental security, and sustainable development. "Over the last three years," Souza continues, "these issues have been conceived in a more integrated manner to develop a bioeconomy".

Another of BIOEN's missions, according to Carlos Henrique Brito Cruz, scientific director of FAPESP, is to engage researchers from the state of São Paulo in an international discussion about policies intended to develop bioenergy. The third staging of BBEST has boosted this goal by attracting attendees from 14 countries, including Brazil. Secretary-general for BBEST 2017 and coordinator of BIOEN, Heitor Cantarella, underscored the Program's calling to promote innovation, which helps encourage an upturn in Brazil's economy through low GHG-emissions strategies.

Highlights

BBEST 2017 was attended by 78 BIOEN-associated researchers. On the next section, we highlight some studies presented during the event.

ENGINEERING SUGARCANE CELL WALL HYDROLYSIS

MARCOS BUCKERIDGE, INSTITUTO DE BIOCIÊNCIAS - USP

Characterizing sugarcane recalcitrance - One of the major obstacles to achieving second-generation ethanol is the difficulty in breaking down the resistance of sugarcane cell walls so as to make the cellulose more accessible to hydrolysis. Marcos Buckeridge's group has demonstrated that the sugarcane cell wall possesses a glycomic code to regulate its characteristics, which is behind this resistance. His group also discovered a mechanism of degradation, and the genes that sugarcane possesses in its roots to "soften" the cell wall, as well as identifying fungi that produce a cocktail of enzymes suitable for obtaining cellulose hydrolysis in the same process.

EDUARDO CESAR | PESQUISA FAPESP

A COMPLEX REGION OF THE SUGARCANE GENOME SYNTENIC TO A SORGHUM QTL LINKED TO SUGAR ACCUMULATION

ANETE PEREIRA DE SOUZA, INSTITUTO DE BIOLOGIA - UNIVERSIDADE ESTADUAL DE CAMPINAS

A comparative methodology between sorghum and sugarcane - Sugarcane possesses a complex genomic code with several copies of each chromosome and countless variants of each gene, all of which hinders sequencing and organization. To overcome this obstacle, the team headed by Anete Pereira de Souza at UNICAMP developed a methodology using markers and QTLs (Quantitative Trait Loci) to investigate the genetic and genomic structure of sugarcane. The group worked on the assumption of a high degree of similarity between the genomes of sugarcane and sorghum, which is simpler, to understand the architecture of the genome region related to the accumulation of sugar in sugarcane. The QTL for Brix (the amount of sugar) was identified in the sorghum genome and used as a benchmark for determining homologous genes in the sugarcane transcriptome.

LÉO RAMOS CHAVES | PESQUISA FAPESP

GENOMIC AND TRANSCRIPTOMIC OVERVIEW OF SHINE (SHN) REGULATORY GRID AND ITS ROLE AS A MASTER REGULATOR OF PLANT SECONDARY CELL WALL BIOSYNTHESIS

MICHAEL DOS SANTOS BRITO, INSTITUTO AGRONÔMICO DE CAMPINAS

Identification of target genes in lignin regulation – The study aims to control lignin biosynthesis; lignin is a macromolecule stiffening and toughening sugarcane and hindering the use of the bagasse. The goal is to identify transcription factors (TFs), the most promising class of genes for modifying the composition of the plant's secondary cell wall. Among TFs, SHINE (SHN), characterised in *Arabidopsis* and overexpressed in rice, has proven to be a good target for manipulation. Genetically modified sugarcane plants with a homolog of the gene are being analyzed with a view to changing the lignin content, which may have an impact on the production of second-generation bioethanol.

LÉO RAMOS CHAVES | *PESQUISA FAPESP*

GENOME-WIDE ASSOCIATION STUDY OF OIL AND FATTY ACIDS IN DIVERSE SOYBEAN GENOTYPES

REGINA HELENA GERIBELLO PRIOLLI, UNIVERSIDADE SANTA CECÍLIA

Genetic markers in soybean for biodiesel – The study aims to discover genetic markers such as SNPs (Single Nucleotide Polymorphism) in GWAS (Genome Wide Association Studies) in order to boost the total oil content found in soybean, as well as change the profile of fatty acids. The group researched the material from 96 different accessions (lineages), with total oil content varying from 10% to 30%, in Brazilian and overseas germplasm banks.The next step was to compare the data obtained in the field with the SNP markers associated with fatty acid synthesis and the total oil contained in the soybean seeds, in order to find genome regions controlling its production. The goal is to genomically map the plant so that soybean breeders can obtain healthier soybean seeds for human consumption, and greater productivity in biodiesel.

A SYSTEMS BIOLOGY APPROACH TO STUDY LIGNIFICATION IN C4 GRASSES

IGOR CESARINO, INSTITUTO DE BIOCIÊNCIAS - UNIVERSIDADE DE SÃO PAULO

Strategies to change lignin metabolism - The group applies systems biology techniques to understand the molecular basis of a range of lignin metabolism aspects, including transcriptional regulation, biosynthesis and polymerization. To achieve this, they applied metabolomics and transcriptomics in order to correlate changes in the composition of the secondary cell wall specific to grasses to variations in gene expression, using *Sorghum bicolor* as a model, with an emphasis on lignin and phenolic metabolism. The goal is to identify genes that are potentially involved in lignin metabolism that might also contribute to plant biomass recalcitrance, and to develop technological strategies to improve bioethanol production.

EDUARDO CESAR | PESQUISA FAPESP

MICROALGAE BIOMASS ACCUMULATION AND LIPID PRODUCTION UNDER THE LENS OF OMICS APPROACHES

FLAVIA V. WINCK, INSTITUTO DE QUÍMICA - UNIVERSIDADE DE SÃO PAULO

An "omics" approach to the study of microalgae - Microalgae have great potential as raw material for the sustainable production of biofuels and commercially interesting chemical bioproducts. However, despite their high lipid biosynthesis capacity, they are not yet a commercially viable option owing to the low productivity of this biomass. This study aims to bring together molecular and genetic information in order to understand how changes in environmental factors (carbon concentration, light and nutrients) can affect the composition and accumulation of biomass, and how these phenotypes can be changed. "Omics" approaches were used (proteomics, metabolomics, transcriptomics and genomics) to understand the structures of the regulatory networks responsible for control of production of biomass, and help in the selection of candidate genes to future biotechnological applications.

ORGAN SPECIFIC RHYTHMS OF TRANSCRIPTION IN FIELD-GROWN SUGARCANE

CARLOS TAKESHI HOTTA, INSTITUTO DE QUÍMICA - UNIVERSIDADE DE SÃO PAULO

LÉO RAMOS CHAVES | *PESQUISA FAPESP*

Impacts of the biological clock in sugarcane metabolism - This study assesses the circadian cycle or variation in sugarcane metabolism determined by the daily solar cycle. The goal is to understand the contribution made by the biological clocks of different organs and tissues in the plant to its environmental adaptation and productivity. The transcriptome, the expression of alternative isoforms and alleles of genes in the biological clocks of different sugarcane organs (leaves and internodals 1/2 and 5) and the effect of shading on its functioning were all studied. The results suggest that the biological clock is functional and synchronized among the different organs. Furthermore, the transcripts regulated by the biological clock and by the environment belong to metabolic, physiological, and genic and epigenetic regulation pathways that are also involved in the plant's yield.

TOTAL RECOVERABLE SUGAR PREDICTION THROUGH AGRONOMIC VARIABLES AND CANOPY SENSING

LUCAS RIOS DO AMARAL, FACULDADE DE ENGENHARIA AGRÍCOLA - UNIVERSIDADE ESTADUAL DE CAMPINAS

Sensing in sugarcane productivity - Faced with technological advances and good outcomes in precision agriculture, it is increasingly perceived that cropping areas are not uniform, but that there are differences in the soil and relief that are reflected in variations in plant growth. This project aims to assess proximal sensing techniques in characterizing agronomic properties of interest for the production of sugarcane. To this end, it seeks to identify agronomical variables associated with vegetation indices in order to estimate total recoverable sugar in sugarcane by hectare, and establish which parameters need to be spatially monitored, focusing on plant productivity.

LÉO RAMOS CHAVES | *PESQUISA FAPESP*

GENETIC MODIFICATION OF SUGARCANE AND RICE TO IMPROVE BIOMASS FOR BIOFUELS

SILVANA CRESTE DIAS DE SOUZA, INSTITUTO AGRONÔMICO DE CAMPINAS

Genes controlling lignin quality – To facilitate the cellulosic ethanol process and make its production economically viable, researchers have, since 2009, devoted themselves to understanding how sugarcane synthesizes lignin. The group is studying four sugarcane genes related to the lignin pathway which have been integrated to the rice and sugarcane genomes to assess the impact of overexpression in the plants. One of them, transcription factor SHINE (SHN) has proven to be an important regulator in the synthesis of the secondary cell wall of rice. The other three direct biosynthesis of the syringyl unit incorporated to the structure of lignin. The understanding and technology are being applied in order to obtain improved sugarcane for the production of second-generation ethanol.

EDUARDO CESAR | *PESQUISA FAPESP*

THE SUGARCANE GENOME

MARIE-ANNE VAN SLUYS, INSTITUTO DE BIOCIÊNCIAS – UNIVERSIDADE DE SÃO PAULO

Integration for sugarcane breeding – The project aims to generate partial sequencing of two sugarcane cultivars (R570 and SP80-3280) and underpin the development of molecular tools to help understand the polyploid genome of the plant, enable discovery of genes and produce knowledge of its complex structure. The current state of knowledge already enables the identification of genes that can be changed in order to enhance sugarcane's traits of interest. In recent years, researchers from the project have begun to create a database to store information on the sugarcane genome.

MARCIA MINILLO | *PESQUISA FAPESP*

SUGARCANE GENOME SEQUENCING AND CHARACTERIZATION USING A SYSTEMS BIOLOGY APPROACH

GLAUCIA MENDES SOUZA, INSTITUTO DE QUÍMICA - UNIVERSIDADE DE SÃO PAULO

EDUARDO CESAR | PESQUISA FAPESP

Target genes for sugarcane breeding – The studies presented at BBEST aim to develop technological tools for sugarcane breeding programs targeting important traits such as increased fiber, sucrose and biomass content. The group compared gene expression networks for the most widely planted variety of sugarcane in Brazil, with three ancestral plants, identifying patterns of gene activity including those related to drought tolerance and cell wall construction. The discoveries pave the way for the identification of biochemical pathways to be altered in genetically modified plants, which may be useful for making bioethanol and new materials in biorefineries.

Biofuels Technologies Division

SYSTEMS BIOLOGY APPLIED TO THE SECRETION OF ENZYMES BY FILAMENTOUS FUNGI

ANDRÉ RICARDO DE LIMA DAMASIO, INSTITUTO DE BIOLOGIA - UNIVERSIDADE ESTADUAL DE CAMPINAS

Fungi produce more enzymes to obtain bioproducts – One of the major challenges to making energy production from biomass more competitive is to bring down the cost of the enzymes used to break down this material. The group's investigations aim to generate recombinant strains of the filamentous fungus *Aspergillus nidulans* for the breakdown of polysaccharides from sugarcane cell walls. By means of the use of system biology tools such as proteomics and transcriptomics, several potential target genes were identified for genetic manipulation. This enabled a two- to three-fold increase in enzyme production for at least three of the mutants generated. From medium to long term the group aims to rationally design fungal mutant strains producing high amounts of enzymes.

LÉO RAMOS CHAVES | PESQUISA FAPESP

CAN THE YEAST KLUYVEROMYCES MARXIANUS GROW UNDER FULLY ANAEROBIC CONDITIONS?

ANDREAS K. GOMBERT, FACULDADE DE ENGENHARIA DE ALIMENTOS - UNIVERSIDADE ESTADUAL DE CAMPINAS

A promising yeast alternative for the ethanol industry - Yeast lineages are deemed strategic for the ethanol industry, but have scarcely been studied. In the present study — as a more suitable alternative for the sugar fermentation stage — we analyze *Kluyveromyces marxianus*, a rapid-growing, heat-tolerant yeast with the ability to metabolize a wide range of sugars, a high secretion/excretion rate and which is relatively easy to manipulate genetically. Although previous studies failed to produce conclusive results, it has been shown that *K. marxianus* has the potential to be used in anaerobic processes like ethanol production. The next step will be to use laboratory evolution to enhance its growth.

LÉO RAMOS CHAVES | PESQUISA FAPESP

CORRELATIONS BETWEEN THE CONCENTRATION OF BIOMASS INHIBITORS AND EFFECTS ON CELLS MASS, ETHANOL AND THEIR PRODUCTIVITIES

CECILIA LALUCE, INSTITUTO DE QUÍMICA - UNIVERSIDADE ESTADUAL PAULISTA

Yeast tolerance in the ethanol pre-treatment process - The first step in the process of obtaining lignocellulosic ethanol consists of the pre-treatment of the material to separate lignin from cellulose and hemicellulose. One of the most widely-studied processes is hydrolysis using diluted acid. However, several by-products are obtained that inhibit the micro-organisms that promote the fermentation of the sugars obtained. This study aims to establish liquid and solid media for studying these effects on fermentation and to establish a cocktail of inhibitors to enable growth, ethanol production, and maintain the feasibility of the yeasts.

EDUARDO CESAR | PESQUISA FAPESP

COMPARATIVE ANALYSIS OF TWO ENDOGLUCANASES FROM GH45 FAMILY MEMBERS WITH BIOTECHNOLOGICAL APPLICATION

FERNANDO SEGATO, ESCOLA DE ENGENHARIA DE LORENA - UNIVERSIDADE DE SÃO PAULO

The use of micro-organisms in enzymatic deconstruction - Lignocellulosic material of plant origin, which is abundant and renewable, provides valuable substrates for countless applications in industry, such as second-generation biofuels, green chemistry and pharmaceutical products. Enzymatic deconstruction of lignocellulosic material is mediated by a mix of multiple enzymes owing to the complex polymeric composition of the biomass. Industrial processes have used the enzymes produced by micro-organisms capable of processing this material. GH45 endoglucanases are not an abundant class but may be exploited for these purposes. This study addresses the cloning, heterological expression, biochemical characterization and comparison of two families of GH45 endoglucanases derived from the fungi *Myceliophtora thermophila* and *Gloeophyllum trabeum*.

HYDRAULIC AND ORGANIC RATES APPLIED TO PILOT SCALE UASB REACTORS FOR SUGARCANE VINASSE DEGRADATION AND BIOGAS GENERATION

VALÉRIA DEL NERY, DEPARTAMENTO DE HIDRÁULICA E SANEAMENTO - UNIVERSIDADE DE SÃO PAULO

LÉO RAMOS CHAVES | *PESQUISA FAPESP*

Anaerobic reactors for vinasse degradation - Sugarcane vinasse, one of the byproducts of ethanol production, is used extensively in fertilization. The content of energy remaining in vinasse, which has not been technologically explored, is very significant in the energy balance. Anaerobic degradation and biogas generation is a suitable option for recovering the energetic potential of vinasse without losing the fertilization potential. Anaerobic reactors at various scales have been used for vinasse degradation and biogas generation. However, the difficulties of maintaining the high rate anaerobic process for vinasse degradation indicate that many steps need investigation to enable projects of high rate compact and efficient anaerobic reactors. The current research assesses the hydraulic rates associated with organic loads applied to pilot-scale UASB reactors to obtain design criteria for reactors to reach high biogas production.

FLEXIBLE PRODUCTION OF BUTANOL AND ETHANOL INTEGRATED TO KRAFT PULP MILLS

ADRIANO PINTO MARIANO, FACULDADE DE ENGENHARIA QUÍMICA – UNIVERSIDADE ESTADUAL DE CAMPINAS

Flexible biorefinery – This study developed a flexible biorefinery annexed to a eucalyptus pulp mill. Following the traditional model of an oil refinery, this one produces chemicals (n-butanol and its co-product acetone) in combination with the biofuel ethanol. In the flex biorefinery, fibers are converted into glucose by enzymatic hydrolysis and the sugars are sent to conventional or specific tanks for fermentation. Flexible production of butanol and ethanol is more economically advantageous than the production of either in isolation.

BIO-OIL AND PHENOLIC RESIN PRODUCTION FROM FOREST PRODUCTS WASTE: A BIOMASS CASCADE APPROACH

ALCIDES LOPES LEÃO, FACULDADE DE CIÊNCIAS AGRONÔMICAS – UNIVERSIDADE ESTADUAL PAULISTA

LÉO RAMOS CHAVES | *PESQUISA FAPESP*

Biomethanol and phenolic resin from biomass – This study, carried out at the request of the Duratex company, aimed to develop a product for its own consumption based on pyrolysis, especially biomethanol and phenolic resin, produced from two types of biomass: eucalyptus bark and MDF residues. Two processes (the slow and rapid pyrolysis pathways) and several variables were tested in order to maximize production. One of the study's conclusions is that the phenolic resin produced by these processes may be used in the partial replacement of the resin from fossil fuels, which would represent a roughly 30% economy for the company in purchasing resins.

DISTILLATION WITH PARALLEL STREAMS APPLIED TO BIOREFINERY MIXTURES

ANTONIO JOSÉ DE ALMEIDA MEIRELLES, FACULDADE DE ENGENHARIA DE ALIMENTOS – UNIVERSIDADE ESTADUAL DE CAMPINAS

EDUARDO CESAR | *PESQUISA FAPESP*

Parallel currents in biorefinery distillation – The separation of thermo-labile, low-volatility mixtures by distillation requires the use of high reflux rates, vacuum, and a large number of separation trays. This also applies to important mixtures for biorefineries like bioethanol and biodiesel. However, this study shows that these problems can be solved by using distillation in parallel currents (parastillation and metastillation).

Engines Division

ETHANOL USE IN TRANSPORTATION: RESEARCH NEEDS

WALDYR L. R. GALLO, FACULDADE DE ENGENHARIA MECÂNICA – UNIVERSIDADE ESTADUAL DE CAMPINAS

Increased ethanol efficiency for transportation – Brazil's average use of biofuels as an energy source (20.7%) is higher than in other countries. Given how important biofuels are for Brazil, carmaker Peugeot-Citroën (PSA) and FAPESP have signed an agreement to set up the Professor Urbano Ernesto Stumpf Research Center to host multidisciplinary studies in the field of biofuels. The plan for the center's first four years of research, entitled "Conceptual study of an advanced ethanol-fueled engine," aims to explore the specificities and positive traits of bioethanol as a fuel and to boost the efficiency of biofuel-driven engines.

EDUARDO CESAR | *PESQUISA FAPESP*

LINKING SOIL MICROBIOME WITH SUSTAINABILITY

EIKO KURAMAE, NETHERLANDS INSTITUTE OF ECOLOGY

The soil microbiome and sustainability – Sustainable agriculture depends on healthy soil and the diversity of micro-organisms to ensure more efficient ecosystem services for crops. Intensification of agriculture requires the integrated management of nutrients in order to maintain crop yields and protect the environment. The present study addresses the use of native bacteria and fungi and the recycling of organic wastes in order to make sugarcane production sustainable. Application of vinasse, a common residue of sugarcane (rich in carbon, potassium and nitrogen) combined with inorganic fertilizers, emits high amounts of nitrous oxide, which process is mainly driven by microbes. The study showed that the main biological process related to N_2O emissions in tropical soils with sugarcane is nitrification by bacteria. In addition, another study showed that nitrification inhibitors might be a practical means of mitigating N_2O emissions in sugarcane fields.

LÉO RAMOS CHAVES | *PESQUISA FAPESP*

ON THE IMPACT OF THE AGRO-ENVIRONMENT: THE NEW PROFILE OF THE SUGAR ALCOHOL OCCUPATION

JOSÉ GIACOMO BACCARIN, FACULDADE DE CIÊNCIAS AGRÁRIAS E VETERINÁRIAS - UNIVERSIDADE ESTADUAL PAULISTA

The impacts of mechanization on rural laborers – The sugarcane industry's Agri-Environmental Protocol of 2007 (Protocolo Agro Ambiental) was signed by public and private sectors alike, and consolidated the mechanized harvesting of sugarcane rather than the traditional method in which the sugarcane is burned and cut. The change was brought about by labor and environmental legislation, market forces, management issues and financial drivers, all of which combined to produce a significant impact on the profile of rural labor, as this study shows. Mechanized harvesting in São Paulo leaped from 42% of fields in 2007 to 85% in 2013, and led, as a result, to a 16% fall in the number of jobs in the sugarcane fields.

EDUARDO CESAR | *PESQUISA FAPESP*

DEVELOPMENT PATHWAYS FOR BIOFUELS INITIATIVES: LESSONS FROM DEVELOPING COUNTRIES

MANOEL REGIS L.V. LEAL, NÚCLEO INTERDISCIPLINAR DE PLANEJAMENTO ENERGÉTICO – UNIVERSIDADE ESTADUAL DE CAMPINAS

Biofuels and developing countries – This study presents conclusions about how the production of biofuels affects developing countries and its impacts on energy and food security. The researcher and a colleague visited two different sugarcane-based biofuel and sugar production programs in 2015: one in Coruripe, Brazil, and the other in Xinavane (sugar only), Mozambique. The regions differ significantly in the yield and profitability of the crop, showing that such factors as local social participation, production diversification, the inclusion of value-added products, and food security policies are the best combination for taking advantage of the economic opportunities that biofuel production can bring to the development of a region.

THE BALANCE OF GREENHOUSE GASES FOR A SUGARCANE PLANTATION IN BRAZIL

OSVALDO MACHADO RODRIGUES CABRAL, EMBRAPA MEIO AMBIENTE

LÉO RAMOS CHAVES | *PESQUISA FAPESP*

Carbon balance in sugarcane fields – This study of a sugarcane plantation in Pirassununga (São Paulo state) measured carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (CH_4) flows almost continuously for 367 days using the eddy covariance method. The measurements began 156 days post-planting and covered the first crop in November 2016: residues were not removed, and ammonia-based fertilizers were applied. The network of ecosystem changes showed that the crop functioned as a carbon sink.

SUSTAINABILITY OF INTENSIFIED PASTURELAND: LAND COVER MONITORING

RUBENS AUGUSTO CAMARGO LAMPARELLI, NÚCLEO INTERDISCIPLINAR DE PLANEJAMENTO ENERGÉTICO – UNIVERSIDADE ESTADUAL DE CAMPINAS

Degraded pastureland and sustainability – Although demand for biofuels is clear, worldwide enthusiasm for bioenergy usually comes up against food production and deforestation. Pasturelands are therefore seen as a promising source of arable land for biofuels and foods. However, the greatest challenge lies precisely in identifying these pasture areas. This study sought to build a library of georeferenced information in order to identify areas of degraded pasture that could be used for the production of feedstocks. The area chosen was the west of the state of São Paulo.

For more details, check out the videos produced during BBEST 2017 at BIOEN-FAPESP's channel on Youtube: https://www.youtube.com/channel/UCx48wzsGAzaS9IODLZ8EmFQ

The presenters of the best posters in each category (Master's, Ph.D. and Post-Doctoral) received their prizes during the closing ceremony of BBEST 2017.

Five of the nine winning studies are co-authored by BIOEN researchers.

Here is a list of winners: we congratulate all of them on their excellent work.

Master's

1ST PLACE

BRUNA TATSUE GRICHOSWSKI NAKAGAWA
INSTITUTO DE BIOLOGIA - UNIVERSIDADE ESTADUAL DE CAMPINAS

Transcriptional and fermentative analysis of Clostridium saccharoperbutylacetonicum during optimized fermentation process using cellulosic pulp


CLAUDIO AROUCA

2ND PLACE

LAERTE ROCHA NEVES PINTO PINTO
INSTITUTO AGRONÔMICO DE CAMPINAS

High nutrient demand and sustainable production of energy cane


CLAUDIO AROUCA

3RD PLACE

LEANDRO CAROLINO GONZAGA
INSTITUTO AGRONÔMICO DE CAMPINAS

Straw removal and nitrification inhibitor as mitigation strategies to N_2O emission in sugarcane fields


CLAUDIO AROUCA

Ph.D.

1ST PLACE

WESLEY MARQUES

FACULDADE DE ENGENHARIA DE ALIMENTOS - UNIVERSIDADE ESTADUAL DE CAMPINAS

CLAUDIO AROUCA

Sucrose hydrolysis has been completely abolished in Saccharomyces cerevisiae using a single CRISPR/Cas9 transformation step

2ND PLACE

GUSTAVO PAGOTTO BORIN

LABORATÓRIO NACIONAL DE CIÊNCIA E TECNOLOGIA DO BIOETANOL and UNIVERSIDADE ESTADUAL DE CAMPINAS

CLAUDIO AROUCA

Identifying potential new genes related to lignocellulose degradation using transcriptome and gene co-expression network analysis in Trichoderma reesei RUT-C30

3RD PLACE

FELLIPE DA SILVEIRA BEZERRA DE MELLO

INSTITUTO DE BIOLOGIA - UNIVERSIDADE ESTADUAL DE CAMPINAS

CLAUDIO AROUCA

Automated high-throughput method for Saccharomyces cerevisiae growth analysis

Post-Doctoral

1ST PLACE

FLÁVIA PEREIRA FRANCO
ESCOLA SUPERIOR DE AGRICULTURA LUIZ DE QUEIROZ - UNIVERSIDADE DE SÃO PAULO

Structural and functional characterization of SUGARWINS and their role in plant defense


CLAUDIO AROUCA

2ND PLACE

MARCELO FALSARELLA CARAZZOLLE
INSTITUTO DE BIOLOGIA - UNIVERSIDADE ESTADUAL DE CAMPINAS

Bioinformatics applications in biotechnology: bioenergy production


CLAUDIO AROUCA

3RD PLACE

BRUNA GONÇALVES DE OLIVEIRA CARVALHO
INSTITUTO AGRONÔMICO DE CAMPINAS

Assessment of the microbial diversity associated with CH_4 production from vinasse


CLAUDIO AROUCA

Global Biobased Business Competition (G-BiB)

Another prize awarded at BBEST 2017 was the Global Biobased Business Competition (G-BiB) challenge, a competition between master's and doctoral students promoted by BE-Basic. Brazilian startup SANergya, set up by master's-level students and lecturers at the University of Taubaté (Unitau, São Paulo state), won the competition, holding off strong challenges from Germany and Holland teams. Each team gave its pitch to a jury made up of international biofuels and biomaterials experts, who then questioned each group. The prize awarded to the winners is worth €10,000 to help carry out their business project, an innovative system producing biogas, biofertilizer and sulfur from anaerobic fermentation of industrial effluents.

CLAUDIO AROUCA

Jan Wery hands over the award of €10,000, provided by Corbion to the team SANergya. SANergya will use the money to set up a pilot plant to scale up their technology.

CHECK THE FOLLOWING PAGES FOR ADDITIONAL INFORMATION, VIDEOS, NEWS AND MORE:

BIOEN-FAPESP

http://bioenfapesp.org/
http://www.fapesp.br/bioen/

https://www.youtube.com/channel/UCx48wzsGAzaS9IODLZ8EmFQ

https://www.facebook.com/Bioen-Fapesp-175507492508393/
https://www.facebook.com/BioenSecretariat/

http://www.researcherid.com/rid/H-6149-2012

https://scholar.google.com.br/citations?user=F5qGdYcAAAAJ&hl=pt-BR

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