CENTER FOR BIOLOGICAL AND INDUSTRIAL PROCESSES FOR BIOFUELS (CeProBIO)

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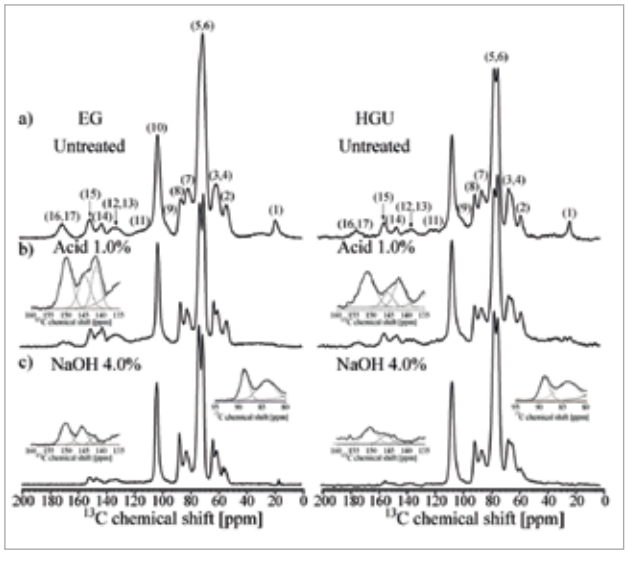

Figure 1. CPMASTOSS NMR spectra of eucalyptus bark samples (Eucalyptus grandis *(EG) and the hybrid,* E. grandis x urophylla *(HGU))* in natura, *after acid and alkaline (NaOH 4%) pretreatment (Lima et al., 2013)*

Center for Biological and Industrial Processes for Biofuels (CeProBIO) is an initiative aimed at articulating the collaborative effort of Brazilian scientific groups already working in various areas of scientific and technological research in the area of biofuels. More specifically, the skills of these groups cover key areas of microbiology, genomics, genetics, molecular and structural biology, enzyme engineering, physical chemistry of the cell wall and bioinformatics, as well as applied disciplines such as mechanical engineering, chemical engineering, environmental engineering and also sustainability, economics and others.

We expect that strong transdisciplinarity and synergies between these skills will enable a quantum leap in the development of technologies of second generation biofuels such as cellulosic ethanol and biodiesel from microalgae. The advances made in this area will materialize in the technologies applicable at a pilot scale and will be based on integrated industrial model, environmentally safe and sustainable, which will serve for study efficiency and process optimization, co-generation of "green" chemicals, waste recovery and optimization of social and economic impacts.

The following eight major projects compose the structural pillars of this proposal: 1. Genetics of plants and microorganisms; 2. Gene discovery and functional genomics to plant cell wall metabolism in cane sugar; 3. Brazilian forests and energy crops for sustainable production of cellulosic, ethanol; 4. Molecular structure of carbohydrates and lignin and the degradation of plant cell walls; 5. Enzymes in bioenergy; 6. Industrial processes for the production of second generation ethanol and co-generation of "green" chemicals; 7. Production of biodiesel from algae in industrial scale and 8. Impacts of biofuel production on water use and carbon emissions.

This proposal will be developed in close collaboration with European proposal SUNLIBB (Sustainable Liquid Biofuels from Biomass), coordinated by Prof. Simon McQueen-Mason, University of York - UK. The SUNLIBB proposal aims at use of genetics, transcriptomics and genomics approaches to improve the quality of biomass for biofuel production; understanding of the polysaccharide composition of the cell wall; cogeneration of products with high added value from biomass; understanding and use of lignin as a raw approach material for the production values; deconstruction of biomass and integrated engineering processes aimed at economic and environmental sustainability in the production of cellulosic ethanol. These aims and objectives are highly complementary with the aims and objectives proposed by CeProBIO and will be performed in a close collaboration between these two centers.

SUMMARY OF RESULTS TO DATE AND PERSPECTIVES

Important advances were achieved in all 8 main projects of the proposal: We´ve conducted molecular genetic mapping of 3 bi-parent populations totalizing over 700 F1 individuals identifying SSR and SNP functional relevant molecular markers, leading to the mapping of important agronomic traits in sugarcane. We also developed and applied the bioinformatics analysis for *de novo* assembly and transcriptome analysis of contrasting sugarcane varieties. Furthermore, novel methodologies for SNPs classification in polyploids and mapping of bi-parent populations with high polyploidy level have been developed and implemented. We built and analyzed full-length enriched cDNA libraries and conducted ORFeome analysis of ancestors (*Saccharum officinarum* and *Saccharum spontaneum*) and one hybrid (SP803280) genotypes. Composition, morphology and processing potential of different sources of Brazilian biomass (including *Panicum maximum*, *Pennisetum purpureum*, *Brachiaria brizantha* and *Eucalyptus*) for sustainable biorenewables and biofuels production were evaluated. Moreover, we determined composition and structure of composition and structure of sugarcane cell wall polysaccharides and studied their implications for second-generation bioethanol production. A number of (hemi)cellulose-active enzymes capable of enhancing lignocellulosic biomass saccharification were identified, produced and tested. We also engineered enzymes and enzyme chimeras with improved biochemical characteristics. Several individual enzymes and enzymatic mixtures were applied to enzymatic hydrolysis of pretreated lignocellulosic biomass. Finally we evaluated impacts of biomass and biofuels production on water usage and carbon emissions, putting forward novel strategies for minimizing environmental impacts and enhancing potential second generation bioethanol production.

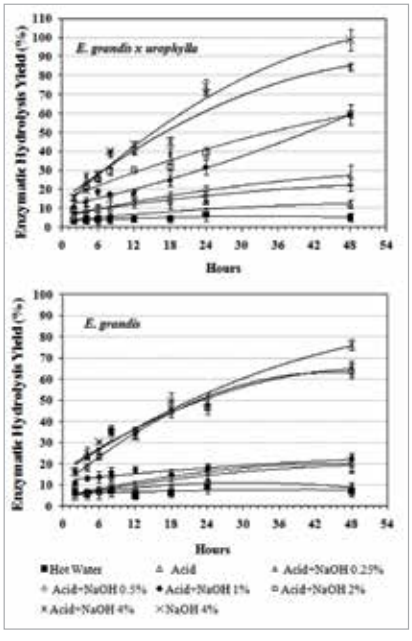

Figure 2. Enzymatic hydrolysis yield obtained for eucalyptus barks after acid and/or alkali treatments along 48 h (Lima et al., 2013)

MAIN PUBLICATIONS

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