

Environmentally sustainable processes for biomass conversion into biofuels and value-added compounds: integrated and intensified approach within a biorefinery concept

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Lignocellulosic biomass conversion into biofuels is considered a promising alternative to replace fossil fuels, being one of investment priorities of European Union to attain a sustainable growth within Horizon 2020. Nevertheless, lignocellulosic biofuels are not widely implemented on large-scale due to the high initial investment and operational costs. The scientific research carried out has been focused in the development of biomass processing technology for bioethanol production making use of environmentally-friendly pre-treatments and molecular biotechnology tools (metabolic, genetic and physiological engineering) for yeast development.

The team has contributed to the development of environmentally-friendly processes for ethanol production following a biorefinery approach. Organosolv using glycerol as green solvent was optimized for fractionation of *Eucalyptus globulus* wood (EGW) in order to obtain a pretreated biomass susceptible to be used at high-solid loadings (>30%) on saccharification and fermentation process, as well as, a recovered lignin and hemicellulose [1]. As far as we know, the ethanol obtained (94 g/L) in this work was the highest ethanol concentration from lignocellulosic biomass reported in the literature [1].

Hydrothermal process as pretreatment (using water as only reaction medium) was also evaluated for the improving of enzymatic saccharification of cellulose to glucose, as well as the recovery of hemicellulose-derived compounds (as oligosaccharides) in liquid fraction in order to revalorize and optimize the process from integrated point of view [2]. By using a selected robust yeast strain, simultaneous saccharification and fermentation (SSF) of whole slurry from hydrothermally pretreated EWG was also optimized, achieving 23 kg of ethanol/100 kg of wood with 85.5% of ethanol yield [2]. Therefore, this approach has been also applied to other lignocellulosic biomasses (such as vine shoots, Paulownia wood, oat straw and Eucalyptus bark).

Together, these studies revealed the importance of integrating different approaches, from pre-treatment to yeast development, for cost-effective production of 2nd generation bioethanol.

References

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- [2] Romaní, A, Ruiz, HA, Pereira, FB, Teixeira, JA, Domingues, L, Integrated approach for effective bioethanol production using whole slurry from autohydrolyzed Eucalyptus globulus wood at high-solid loadings, *Fuel*, 135, 485-491, 2014.