Enzymatic pretreatment of eucalyptus pulp to produce cellulose nanofibers and biobutanol in an integrated biorefinery

Florencia Cebreiros[1], Santiago Seiler[2], Mario Daniel Ferrari[1], Claudia Lareo[1]

[1]*Universidad de la República, Uruguay*

[2]*University of British Columbia, Canada*

Corresponding author: Florencia Cebreiros >fcebreiros@fing.edu.uy<

The production of chemicals, materials and fuels from renewable sources remains an important step in the transition to a sustainable and clean energy economy. Moreover, the integrated production of biofuels and value-added coproducts from the different components in lignocellulosic biomass has emerged as a goal for lignocellulosic biorefineries to achieve economic self-sustainability. Nanocellulose is a renewable nanobiomaterial with potential applications in material science and biomedical engineering. For nanocellulose production, enzymatic treatment represents an environmentally friendly alternative to chemical pretreatment due to high enzyme specificity and less harmful reaction conditions. The use of hydrolytic enzymes to produce nanocellulose from cellulosic biomass allows the coproduction of sugars that can be converted into high value-added chemicals such as biobutanol, in an integrated biorefinery. Therefore, the recovery of a fermentable sugar stream during nanocellulose production results critical.

In the present study, the production of cellulose nanofibers and biobutanol from bleached eucalyptus Kraft pulp by enzymatic pretreatment was investigated. The combination of enzymatic and mechanical pretreatment yielded cellulose nanofibers with diameters in the range of 3-10 nm, constituting a potential strategy for nanocellulose isolation from bleached eucalyptus Kraft pulp. Physicochemical characterization showed high quality nanobiomaterial obtained for further potential applications. A cellulose nanofiber yield of 40% was achieved after 4 h of enzymatic hydrolysis, indicating that production of nanocellulose by enzymatic pretreatment effectively afforded a considerable amount of sugars (18 g/L glucose and 5 g/L xylose) release as a coproduct. The native strains *C. beijerinckii* DSM 6422 and *C. beijerinckii* DSM 6423 presented a remarkable ability to ferment the sugars stream to butanol via ABE (acetone-butanol-ethanol) or IBE (isopropanol-butanol-ethanol) fermentation, respectively. Both microorganisms were able to completely consume sugars after 24-48 h of fermentation, producing butanol and total solvents concentrations of 4-5 g/L and 7-8 g/L, respectively. The proposed process represents a promising strategy towards an integrated biorefinery for the coproduction of cellulose nanofibers and butanol.