Danila Morais de Carvalho et al., J Bioremediat Biodegrad 2018, Volume 9
DOI: 10.4172/2155-6199-C1-014

The strategic use of sugarcane for second-generation ethanol production: Cold alkaline extraction pretreatment

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The global demand for more sustainable alternatives for supplying fuels, energy, chemicals, materials etc. has attracted great attention of researchers and industries currently. The increasing use of lignocellulosic biomass as feedstock is a good example about how industry has investigated potential substitutes for the traditional fossil sources. The ethanol is an alcohol usually obtained from renewable sources by fermentation process and widely used for chemical and fuel purposes. In tropical areas, the main feedstock for ethanol production is the sugarcane, from which only the sugarcane juice is used within the production process. However, the strategic use of its lignocellulosic residues, *i.e.* bagasse and straw, in technologies for second-generation ethanol production presents great logistic advantages, with potential for enhancing the sugarcane industry profitability by integrating first and second-generation platforms. The second-generation ethanol production, however, faces nowadays some challenges to be commercially implemented, being one of them the biomass pretreatment. The cold alkaline extraction (CAE) is an efficient method to remove substantial amounts of hemicelluloses and lignin from biomasses. Performed in low temperature (20-40°C), CAE requires just relatively simple instrumental (unpressured reactor). In the present study we investigated the CAE pretreatment for bagasse and straw preparation and the ethanol production through semi-simultaneous saccharification and fermentation (SSSF) (Fig. 1). To the best of our knowledge, although used in other industrial segments, the use of CAE for treating biomass for ethanol production had not been explored before, especially in combination with SSSF. A removal of 52-61% xylan and 37-45% lignin from biomasses was observed during CAE process. Biomasses depleted in hemicelluloses and lignin were more susceptible to SSSF process, increasing the volumetric productivity of ethanol in 11.6 times and 15 times compared with untreated bagasse and straw, respectively. The volumetric productivity of ethanol was 0.29 g/L/h and 0.57 g/L/h for bagasse and straw, respectively.

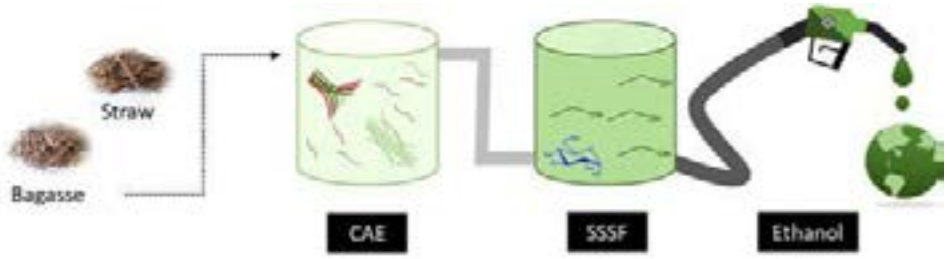

Figure 1: Working plan for second generation ethanol production from sugarcane bagasse and straw using cold alkaline extraction pretreatment.

Recent Publications

1. Carvalho DMde, Queiroz JHde, Colodette JL (2017) Hydrothermal and acid pretreatments improve ethanol production from lignocellulosic biomasses. BioResources 12(2):3088-3107.
2. Carvalho DMde, Colodette JL (2017) Comparative study of acid hydrolysis of lignin and polysaccharides in biomasses. BioResources 12(4):6907-6923.
3. Carvalho DMde, Queiroz JHde, Colodette JL (2016) Assessment of alkaline pretreatment for the production of biethanol from eucalyptus, sugarcane bagasse and sugarcane straw. Industrial Crops and Products 94:932-941.
4. Carvalho DMde, Sevastyanova O, Queiroz JHde, Colodette JL (2016) Cold alkaline extraction as a pretreatment for bioethanol production from eucalyptus, sugarcane bagasse and sugarcane straw. Energy Conversion and Management 124:315-324.

5. Carvalho DMde, Sevastyanova O, Penna LS, Silva BPda, Lindström ME, Colodette JL (2015) Assessment of chemical transformations in eucalyptus, sugarcane bagasse and straw during hydrothermal, dilute acid, and alkaline pretreatments. Industrial Crops and Products 73:118-126

Biography

Danila Carvalho has her expertise multiple use of lignocellulosic biomasses. During recent years the main goal of her research was to turn lignocellulosic wastes into renewable alternatives of feedstock for industry. Her recent project on bioethanol production from sugarcane residues confirmed the great potential of use of such biomasses in industry, including in the sugarcane industry itself. The strategic integration of first and second ethanol platforms, in addition to promote a greener and profitable use of lignocellulosic biomasses, results in an undeniable enhancing in ethanol production.

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