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Using Hemicellulosic Liquor from Sugarcane Bagasse to Produce Second Generation Lactic Acid

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Abstract : Lactic acid, besides a valuable chemical may be considered a platform for other chemicals. In fact, the feasibility of hemicellulosic sugars as feedstock for lactic acid production process, may represent the drop of some of the barriers for the second generation bioproducts, especially bearing in mind the 5-carbon sugars from the pre-treatment of sugarcane bagasse. Bearing this in mind, the purpose of this study was to use the hemicellulosic liquor from sugarcane bagasse as a substrate to produce lactic acid by fermentation. To release of sugars from hemicellulose it was made a pre-treatment with a diluted sulfuric acid in order to obtain a xylose's rich liquor with low concentration of inhibiting compounds for fermentation (≈ 67% of xylose, ≈ 21% of glucose, ≈ 10% of cellobiose and arabinose, and around 1% of inhibiting compounds as furfural, hydroxymethilfurfural and acetic acid). The hemicellulosic sugars associated with 20 g/L of yeast extract were used in a fermentation process with Lactobacillus plantarum to produce lactic acid. The fermentation process pH was controlled with automatic injection of Ca(OH)2 to keep pH at 6.00. The lactic acid concentration remained stable from the time when the glucose was depleted (48 hours of fermentation), with no further production. While lactic acid is produced occurs the concomitant consumption of xylose and glucose. The yield of fermentation was 0.933 g lactic acid /g sugars. Besides, it was not detected the presence of by-products, what allows considering that the microorganism uses a homolactic fermentation to produce its own energy using pentose-phosphate pathway. Through facultative heterofermentative metabolism the bacteria consume pentose, as is the case of L. plantarum, but the energy efficiency for the cell is lower than during the hexose consumption. This implies both in a slower cell growth, as in a reduction in lactic acid productivity compared with the use of hexose. Also, L. plantarum had shown to have a capacity for lactic acid production from hemicellulosic hydrolysate without detoxification, which is very attractive in terms of robustness for an industrial process. Xylose from hydrolyzed bagasse and without detoxification is consumed, although the hydrolyzed bagasse inhibitors (especially aromatic inhibitors) affect productivity and yield of lactic acid. The use of sugars and the lack of need for detoxification of the C5 liquor from sugarcane bagasse hydrolyzed is a crucial factor for the economic viability of second generation processes. Taking this information into account, the production of second generation lactic acid using sugars from hemicellulose appears to be a good alternative to the complete utilization of sugarcane plant, directing molasses and cellulosic carbohydrates to produce 2G-ethanol, and hemicellulosic carbohydrates to produce 2G-lactic acid.

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