

ABSTRACT

HYDROLYSIS AND ETHANOL POTENTIAL OF
SELECTED INDIGENOUS CELLULOSICS

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Most of the research and development on the substitution of conventional liquid fossil fuels has centred on biomass utilisation. Ethanol, which can be used as a fuel, fuel enhancer, chemical feedstock and food beverage, can be derived from cellulosics, a form of biomass. The basic process for ethanol production is by the hydrolysis of the cellulosic carbohydrates, hemicellulose and cellulose, to simple sugars which are in turn fermented to ethanol.

The four cellulosic materials used were guinea grass (Panicum maximum), sugar cane tops (Saccharum officinarum), banana leaves (Musa acinumata cv. Gros Michel), and banana leaves and trunk which were called banana parts. The materials were sundried, milled and hydrolysed using two different acids, sulphuric acid and hydrochloric acid.

The sulphuric acid hydrolysis was done in two stages. For the dilute acid stage, the optimum

acid concentration was in the range of 10-12% H_2SO_4 with 3.0% sugar being produced. In the concentrated acid stage, the optimum acid concentration was between 73-80% H_2SO_4 with a corresponding 2.8% sugar produced.

The hydrochloric acid process was a unique and innovative two stage hydrolysis done under vacuum. The optimum reaction time for the gas phase hydrolysis was between 25-30 minutes, with the corresponding sugar in the filtrate being 4.0%, 3.5%, 3.7% and 3.4% for guinea grass, cane tops, banana leaves and banana parts respectively. The percentage sugar in the neutralised condensate was about 2.5% for all the materials. In the liquid phase hydrolysis 7.0-9.0% sugar was obtained. A greater conversion was obtained with hydrochloric acid hydrolysis than with sulphuric acid.

All the prehydrolysates were fermented with Fusarium oxysporum, and the hydrolysates with Saccharomyces cerevisiae. Ethanol yields after sulphuric acid hydrolysis were 92.44 L/tonne for guinea grass and 55.75 L/tonne for cane tops. Ethanol yields after hydrochloric acid hydrolysis were, for guinea grass 67.20 L/tonne, cane tops 64.90 L/tonne, banana leaves 38.27 L/tonne and banana parts 21.40 L/tonne. A preliminary alcohol plant design based on preliminary estimates was also done.