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Conversion of Fibrous Sago (*Metroxylon sagu*) Waste into Fermentable Sugar via Acid and Enzymatic Hydrolysis

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Abstract: The hydrolysis of dried-powdered fibrous sago waste by sulphuric acid and glucoamylase was studied. Both studies were carried out in an Erlenmeyer flask placed in a controlled temperature water bath. Samples were taken from the reaction flask at every 30 min interval for reducing sugar determination. The optimum condition for acid hydrolysis was found to be at 90°C, using 1.5 M acid concentration and reaction time of 120 min yielding 0.6234 g glucose g^{-1} waste. The kinetic parameters of acid hydrolysis in the Saeman's model, were the rate constant (k_1 = 0.01405 (1/min)), activation energy (Ea =120.40 (kJ mol^{-1})) and pre-exponential factor (A = 9.52×10^{16} (1/min)). The optimum condition for enzymatic hydrolysis using glucoamylase was found to be at enzyme concentration of 6 AGU mL^{-1} and reaction time of 30 min, yielding 0.5646 g glucose g^{-1} waste. The kinetic parameters in the competitive inhibition model corresponding to the optimum condition, namely the equilibrium constant for enzyme-inhibitor complex, Michaelis-Menten constant and maximum velocity, are 1.4727, 0.24175 and 1.35460 g L^{-1} min, respectively.

Key words: Hydrolysis, lignocellulosic waste, sulphuric acid, glucoamylase, kinetic modelling

INTRODUCTION

Sago palm (*Metroxylon* sp.) is one of the few tropical crops with the ability to thrive in the harsh swampy peat environment (Johnson, 1977; Ruddle, 1977). In Malaysia, this type of land covers an area of 1.5 million ha or about 12% of Sarawak's total land area (Tie and Lim, 1977). Cecil *et al*. (1982) reported that sago starch accumulates in the pith core of the stem of the sago palm. They also reported that the chemical analysis of pith showed about 6-12% of soluble solids (dry substance) and 1-3% of ash, besides from 79-88% of apparent starch plus sugar content. The sago pith also contains most of the constituents in any other plant materials namely fibre, hemicelluloses, other cell structural materials, soluble solids and unidentified traces of other substances.

Beside wastewater and bark, residual solid waste is produced by sago processing plant daily. The residual solid waste is the fibrous residue obtained after the starch has been washed out of the rasped pith of the sago palm. Due to the presence of the lignocellulosic fibrous material, this refuse is a strong pollutant with no significant industrial application except as animal feed supplement and chipboard production. However, dried fibrous sago waste has been found to

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