BIOETHANOL PRODUCTION FROM OIL PALM EMPTY FRUIT BUNCH

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Abstract –

This research aimed to study bioethanol production from Oil Palm Empty Fruit Bunches (OPEFB) with Simultaneous Saccharification and Fermentation (SSF) and Separate Hydrolysis and Fermentation (SHF) by Klyveromycesmarxinus. The basic steps for bioethanol production from lignocellulosic biomass are1) pretreatment for delignification, which is necessary to liberate cellulose and hemicellulose;2) hydrolysis of cellulose and hemicellulose to generate fermentable sugars; and3) fermentation of bioethanol from sugars. In step (1) OPEFB was subjected to acid-alkali pretreatment with a diluteacid solution (at substrate loading 12.50 %w/v, sulfuric acid concentration 0.2 M, at 121 ºC for 53 min) followed by an alkali solution (NaOH 5 %w/v, at 121 ºC for 20 min),which resulted in 72.10 %wt cellulose yield with hemicellulose and lignin yields of 3.24 %wt and 17.60 %wt, respectively. Then the optimal conditions for ethanol production by SSF process wereinvestigated by Response Surface Methodology (RSM). The four manipulated factors were temperature (30-45 ºC), substrate loading (5-15 % w/v), pH (4-6),and yeast concentration (1-5 %v/v), and the maximal 0.281 g/g bioethanol yield was found at 12.24 %w/v, pH 4.5, yeast concentration 2.04 %v/v, and 36.94 ºC. In SHF, hydrolysis and fermentation steps were conducted at the optimal conditions for SSF, giving 0.584 g/greducing sugar and 0.258 g/g bioethanol yield. The results demonstrate that an acid-alkalipretreatment could remove hemicellulose and lignin from lignocellulosic biomass, increasing cellulose yield,while SSF performed better than SHF with both quicker processing and higher bioethanol concentration.

Keywords - Bioethanol, Oil Palm Empty Fruit Bunch, Acid-Alkali pretreatment, Kluyveromycesmarxianus, Simultaneous Saccharification and Fermentation