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CO-FERMENTATION OF EFB AND GLYCEROL FOR ENHANCED BIOETHANOL PRODUCTION

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CO-FERMENTATION OF EFB AND GLYCEROL FOR ENHANCED BIOETHANOL PRODUCTION

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ABSTRACT

CO-FERMENTATION OF EFB AND GLYCEROL FOR ENHANCED BIOETHANOL PRODUCTION

The growing demand for sustainable energy has prompted the exploration of lignocellulosic biomass as a renewable feedstock for bioethanol production. This study investigates the co-fermentation of empty fruit bunch (EFB) hydrolysate and crude glycerol using *Saccharomyces cerevisiae* to enhance ethanol yield and fermentation efficiency. EFB was subjected to an initial step of acid and alkaline pretreatment followed by a second step of enzymatic hydrolysis to liberate fermentable sugars from EFB hydrolysate before performing co-fermenting of EFB and glycerol.The resulting hydrolysate was co-fermented with glycerol at varying ratios EFB:glycerol (v/v) such as 25:0, 25:75, 50:50, 75:25, and 0:25 to determine the optimal substrate combination. Ethanol concentration and percentage yield were determined by GC-MS and based on a validated calibration curve that ensures correct quantitation. Only the EFB:glycerol of 25:75 (v/v) mixture showed measurable ethanol production, resulting in a measured concentration of 2165 ppm, yield of ethanol at 85%, fermentation efficiency at 84.9%, and productivity of 0.00644 g/L/h. These results indicate a high utilization of fermentable sugars (glucose) from EFB hydrolysate and that the addition of glycerol to the fermentation process had a positive impact on microbial metabolism and conversion of substrate to ethanol. It was further verified through use of Fourier Transform Infrared (FTIR) analysis that the lignin and hemicellulose contents of EFB were reduced. Thus, the effective removal of hemicellulose and degradation of lignin was detected at peak around 1510 – 1730 cm^{-1} via the pretreatment process resulting in an enriched substrate of cellulose that is more accessible to microbial fermentation. In summary, the findings of this study support the conclusion that the simultaneous fermentation of EFB hydrolysate and glycerol is an effective and advantageous method to produce bioethanol sustainably, with the best ratio identified at 25% EFB hydrolysate (25:75). Furthermore, this research offers important information on how to maximize the production potential of dual-substance fermentation and the opportunity to repurpose waste material from agriculture and the food industry into renewable energy sources.

TABLE OF CONTENTS