Analysis of a Continuous Dark Fermentation System for Biohydrogen Production from Raja Banana Peel Waste Using Variations in OLR and Catalyst Concentration

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ABSTRACT

Reliance on fossil fuels has driven the development of environmentally friendly renewable energy sources, one of which is biohydrogen. This study aims to analyze the effect of variations in Organic Loading Rate (OLR) and hydrogen peroxide (H_2O_2) catalyst concentration on biohydrogen production volume and Volatile Solid (VS) values, as well as to determine the optimal process conditions in a continuous dark fermentation system using plantain peel waste as a substrate. The study was conducted experimentally using OLR variations of 70, 80, and 90 g/day and H_2O_2 concentrations of 0.6, 0.8, and 1 mM. Gas volume was measured using the water displacement method, while VS was analyzed gravimetrically. Data were processed using the Response Surface Method (RSM) via Minitab 21 software. The results showed that variations in OLR and H_2O_2 concentration affected biohydrogen volume and VS values. The highest gas production observed was at an OLR of 90 g/day and an H_2O_2 concentration of 0.8 mM, yielding a volume of 28 mL, while the highest VS value was obtained at an OLR of 90 g/day and an H_2O_2 concentration of 1 mM, amounting to 93.44%. The RSM optimization results indicate that the optimal biohydrogen volume was achieved at an OLR of 90 g/day and an H_2O_2 concentration of 0.8586 mM, with a predicted volume of 26.0431 mL and a desirability of 0.9247. The optimal VS conditions were obtained at an OLR of 90 g/day and an H_2O_2 concentration of 0.8665 mM, with a VS value of 93.68% and a desirability of 1.000. The results of the study indicate that increasing the OLR and adding H_2O_2 at the optimal concentration can improve biohydrogen production performance in a continuous dark fermentation system.

***Key words**: biohydrogen, continuous dark fermentation, hydrogen peroxide (H_2O_2), plantain peel, Organic Loading Rate (OLR).*