Optimization of a Continuous Dark Fermentation System for Biohydrogen Production from Raja Banana Peel Waste Using Different H_2O_2 Catalysts and pH Levels

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ABSTRACT

The increasing demand for energy and the environmental impacts of fossil fuel use have driven the development of environmentally friendly renewable energy sources, one of which is biohydrogen. This study aims to analyze the effects of varying concentrations of hydrogen peroxide (H_2O_2) catalyst and pH on biohydrogen gas production and Volatile Solid (VS) values, as well as to determine the optimal conditions for biohydrogen production using the Response Surface Method (RSM). The study was conducted using plantain peel waste as the substrate and a mixed inoculum of tofu waste and cow manure in a continuous dark fermentation system. The H_2O_2 concentrations varied at 0.6 mM, 0.8 mM, and 1 mM, while the pH levels were 5, 6, and 7. The parameters observed included biohydrogen gas volume and VS values. The data were analyzed using Minitab 21 software with an RSM approach. The results showed that the highest biohydrogen gas volume was obtained at an H_2O_2 concentration of 0.8 mM and a pH of 6, with a gas volume of 29 mL. The highest VS value was obtained at an H_2O_2 concentration of 1 mM and a pH of 7, at 93.84%. The RSM optimization results indicate that the optimal conditions for biohydrogen gas production are within the range of 0.8 mM H_2O_2 concentration and pH 6, with a predicted volume of 27.431 mL and a desirability value of 0.9129. The constructed model has an R-Square value of 79.47% for biohydrogen gas volume and 92.32% for VS, thus explaining the relationship between the research variables with a good to very good level of fit.

Key words: biohydrogen, continuous dark fermentation, hydrogen peroxide (H_2O_2), plantain peel, Response Surface Method (RSM).