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EFFECT OF pH ON FERMENTATIVE HYDROGEN PRODUCTION FROM L-ARABINOSE USING MIXED CULTURES

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ABSTRACT

Hydrogen is now considered one of the alternatives to fossil fuels. It is preferred to biogas or methane because hydrogen is not chemically bound to carbon and therefore, combustion does not contribute to green house gases or acid rain [1]. One alternative to sustainable H_2 energy production from renewable energy sources is through microbiological fermentation. There have been many studies examining the effect of pH in fermentative hydrogen production from glucose and sucrose using mixed microflora [2,3,4,5,6]. However, fermentative hydrogen production from arabinose, one of the most common pentoses and a component of various biopolymers such as hemicellulose and plant polysaccharides using mixed microflora has not been previously examined. Understanding the influence of pH on biohydrogen production is necessary to develop arabinose-based hydrogen fermentation applications, such as the use of agricultural wastes.

Biohydrogen production from arabinose was examined using three different anaerobic sludges with different pHs ranging from 4.5 to 8.0. Arabinose (30 g/L) was used as the substrate for all experiments. Individual cumulative hydrogen production data were used to estimate the three parameters of the modified Gompertz equation. This model has been used for describing the progress of cumulative gas production obtained from the batch experiments. Higher hydrogen production potentials (more than 35 mL) were observed with pH values greater than 6.0 for Unicer (granular sludge) and Choupal (disperse anaerobic digester sludge supplemented with fat) and greater than 6.5 for Freixo (disperse anaerobic digester sludge). Choupal biomass had the largest hydrogen production rate (4.8±1.4 mL/h) at pH 7.5, compared with the other two sludges. Unicer biomass had the shortest lag time (10.6±2.4 h) at pH 8.0. The highest hydrogen yield was observed with Choupal biomass (2.5 mol H_2/mol arabinose consumed), with pH 6.0. The granular biomass showed different behaviour than the suspended biomasses. The differences may be explained by smaller lag phases, the percentage of acetate produced, the higher percentage of ethanol produced, and the amount of arabinose consumed. The percentage of n-butyrate was highly correlated with the percentage of acetate (R2 = 0.980) in Freixo biomass. A high correlation (R2 = 0.973) was observed between the percentage of n-butyrate and the percentage of ethanol in Unicer biomass, suggesting that the fermentation is following the butyrate/ethanol pathways which correspond to the lower yields of hydrogen obtained.

Keywords: bio-hydrogen; L-arabinose; pH; microbiological fermentation; granular biomass; disperse biomass

Theme: Biogas and Biohydrogen

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