Optimization of Photo-Fermentative Hydrogen Production using Volatile Fatty Acids

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ABSTRACT

Biohydrogen yield can be incremented by using the volatile fatty acids, generated in the dark fermentation process, in a photo-fermentation process. In the present study, the optimum concentration of mixtures of volatile fatty acids for hydrogen production was evaluated using a response surface methodology (Box Behnken and Central Composite designs). A phototrophic hydrogen-producing consortium obtained from a bio-electrochemical system was enriched and used for experiments. The tests were conducted in serological bottles with a nitrogen-free environment. Bottles were mixed at 100 rpm and, 100 mg L^{-1} of biomass (as volatile suspended solids) was used. Temperature was maintained at and 35 °C and the reactors were illuminated under a constant radiation of 5000 lux. It was observed that high propionic acid concentrations caused inhibition of hydrogen production. A decrease on hydrogen production with the increase pH, due to ammonia formation (from 0.4 to 10.8 mg L^{-1}), was observed. The optimal conditions were found when acetic, propionic and butyric acids concentrations were 1200 mg L^{-1}, 715 mg L^{-1} and 1571 mg L^{-1}, respectively. Under such conditions hydrogen production rate was as much as 6.5 mmol d^{-1} L^{-1} and the maximal amount of hydrogen produced was 108.8 mmol L^{-1}.

Keywords: Photo-fermentation, hydrogen, volatile fatty acids