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Entitled

BIOHYDROGEN PRODUCTION OF A CO-CULTURE CONSISTING OF HALOPHYTIC CYANOBACTERIUM PHORMIDIUM KUETZIGIANUM AND ACTIVATED SLUDGE BACTERIA USING DIFFERENT EXOGENOUS CARBON SUBSTRATES AND SALT CONCENTRATION

BY

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Abstract

Various studies have proved the ability of different types of cyanobacteria and algae to produce H_2 by splitting water molecules into hydrogen (H_2) and oxygen (O_2) using specialized enzymes (hydrogenase and nitrogenase) through the biophotolysis process. However, the production of O_2 acts as the main process inhibitor. Several researchers studied this O_2 sensitivity and proposed effective solutions to regulate O_2 concentration. By co-culturing algae with aerobic bacteria, the consumption of the resulting oxygen could be attained and thus reducing the sensitivity of the enzyme to the evolved O_2. In this study, a microbial consortium (co-culture) consisting of cyanobacteria *Phormidium keutzingianum* and activated sludge bacteria was established to regulate O_2 concentration and enhance H_2 production. Different co-culturing ratios (algae: bacteria) such as 2:1,1:1 and 1:2 were tested to find the optimum ratio for H_2 production. The effects of different exogenous carbon substrates (simple sugars) such as glucose, sorbitol, and mannitol were analyzed by supplementing the co-cultures with 10 g/L of sugar. In addition to study the effect of salt (NaCl) on H_2 production, different salt concentrations of 0, 10 and 20 g/L were tested. Results indicated that the amount of cumulative H_2 produced changed significantly by varying the carbon substrate. Glucose-supplemented co-culture produced the lowest amount of H_2 (278 ml L^{-1}) as compared to sorbitol-supplemented co-culture which produced the maximum amount of H_2 (980 ml L^{-1}). On the other hand, mannitol-supplemented co-culture produced (562 ml L^{-1}) of H_2. The results also showed that the addition of salt (NaCl) negatively affected H_2 production. By increasing the salinity level from 0-2%, the amount of total gas produced by glucose-supplemented co-culture was reduced from 2275 ml L^{-1} to 734 ml L^{-1}, whereas cumulative H_2 reduced from 980 ml L^{-1} to 176.8 ml L^{-1} and 562 ml L^{-1} to 333 ml L^{-1} in sorbitol and mannitol-supplemented co-culture, respectively. This study proved the possibility of biohydrogen production by utilizing simple sugars and it can cause significant variations in the amount of the produced H_2 due to the differences in the metabolic pathways of different sugars by the involved algal and bacterial cells. This study also shows that physical factors (such as the effect of salt) affected the H_2 production process due to variations in the tolerances of the involved cyanobacterial and bacterial cells toward different salt concentrations.

Keywords: Algae, Salt tolerance, Hydrogenase enzyme, Nitrogenase enzyme, Wastewater, Metabolism, Chlorophyll