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Effects of types of photobioreactor, light, and nitrogen availability on the bioenergy production potential and CO_2 fixation by *Thermosynechococcus* CL-1

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A thermophilic cyanobacterium named *Thermosynechococcus* CL-1 (TCL-1) was cultivated to evaluate the effects of light and nitrogen availabilities. Two different photobioreactors, shaped in flat plate and tubular, were used for comparing the biomass production, CO_2 fixation, and bioethanol production potential by TCL-1. Both of light and nitrogen availability affect the growth of TCL-1dramatically. As a strong illumination of 1,000 μE m^{-2} s^{-1} was adopted to cultivate TCL-1 in an 1.5 cm light path photobioreactor, the high biomass productivity of 116 mg L^{-1} h^{-1} is reached. Even though the illumination increases to 2,000 μE m^{-2} s^{-1}, the biomass productivity is not influenced by the strong illumination. High CO_2 fixation rate and carbohydrate production rate reach to 170 and 67 mg/L/h, respectively, under the same illumination of 1,000 μE m^{-2} s^{-1}. Various NO_3- fluxes were adopted to evaluate the nitrogen availability of TCL-1 in a tubular photobioreactor. It shows that decreasing the NO_3- flux from N-replete level to N-deprived level (1.01 mM d^{-1}) enhances the carbohydrate content in TCL-1 to 45%. However, increasing the NO_3- flux from N-deprived level (1.01 mM d^{-1}) to N-replete level decreases the carbohydrate content significantly. No matter the NO_3- flux decreasing from N-replete level (8.35 mM d^{-1}) to N-deprived level (1.01 mM d^{-1}) or increasing from N-deprived level to higher N-level, the peak biomass yield occurs at the same NO_3- flux level, 4.18 mM d-1. In addition, the peak lipid yield, carbohydrate yield, and the CO_2 fixation rate were recorded at 482 and 660 mg L^{-1} d^{-1}, and 3.9 g L^{-1} d^{-1}, respectively, under the same NO_3- flux level (4.18 mM d^{-1}). It reveals that both of flat plate and tubular photobioreactors exhibit high potential for CO_2 fixation and bioethanol production.

Biography

Hsin Chu received his B.S. in civil engineering and M.S. in environmental engineering from National Taiwan University. He received his Ph.D. in environmental health engineering from Northwestern University in the US. He started his professional career in Energy & Resources Laboratories, Industrial Technology Research Institute back in Taiwan in March 1988. He accepted a faculty position in the Department of Environmental Engineering, National Cheng Kung University in 1991. He is a distinguished professor now. Prof. Chu has research interests on NOx/SOx removal from conventional flue gas, H2S/COS/HCl removal from gasified coal gas, catalytic and photocatalytic conversion of VOCs, resource reuse, chemical looping combustion, CO_2 mitigation, and microalgae cultivation and bio-fuels production.

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