



光的可利用性對於嗜熱藍綠菌在固碳與生質能生產之影響

Effects of light availability on the CO<sub>2</sub> fixation and bioenergy production of *Thermosynechococcus* sp.

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### 研究重點

A thermophilic cyanobacterium named *Thermosynechococcus* CL-1 (TCL-1) was cultivated in this study to eliminate the energy input of cooling system in flat plate photobioreactors. Cultivating TCL-1 in the 1.5 cm light path flat plate photobioreactor exhibited stable characteristics for biomass production, CO<sub>2</sub> fixation, and carbohydrate production under high illumination conditions (1000 or 2000  $\mu\text{E m}^{-2} \text{s}^{-1}$ ). The greatest biomass and carbohydrate productivity, and CO<sub>2</sub> fixation rate were recorded at 116, 67, and 170 mg/L/h, respectively, in the 1.5 cm light path photobioreactor and under optimal biomass concentration (about 3 g/L). Cultivating *Thermosynechococcus* CL-1 in flat plate photobioreactors exhibits high potential for biomass production, CO<sub>2</sub> fixation and bioethanol production.

### 研究成果

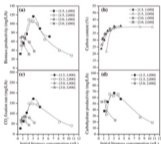


Fig. 1. Effect of biomass concentration, light intensity (1,000 and 2,000  $\mu\text{E m}^{-2} \text{s}^{-1}$ ), and the light path of the photobioreactors (1.5 and 3.0 cm) on the (a) biomass productivity, (b) carbon content, (c) CO<sub>2</sub> fixation rate, and (d) carbohydrate productivity of TCL-1. [Light path of the photobioreactor, light intensity illuminated on the photobioreactor surface] represents the cultivation conditions. The aeration rate was maintained at 0.5 vvm.

### 研究生活及心得

研究的生活是辛苦的，必需犧牲掉部分家人朋友生活的時間。但成果是豐碩的，尤其在獲得自己與別人的肯定時，就值得了。感謝我的指導教授的提攜與教導，及中技社在我國碩時給我的幫助與心靈上的力量，使我的研究得以延續下去，再次感謝中技社的幫助，謝謝。未來，若有能力幫助學者研究人員，我亦願意將此舉事延續下去使台灣的研發能量往上推進。

(A) Effects of the light intensity, light path, and biomass concentration on the biomass production of TCL-1

- (1) The biomass productivity is determined by the light intensity, light path, and the biomass concentration (Fig. 1a). Increasing the light intensity under the 1.5 cm light path photobioreactor has no obvious enhancement of the biomass productivity. The stable characteristics under the 1.5 cm light path photobioreactor may be a good choice for the biomass production of TCL-1 while cultivating TCL-1 under large variation of the light intensity such as outdoors.
- (2) The shorter light path (1.5 cm) photobioreactors are suggested for cultivating TCL-1 at higher biomass concentration ( $\approx 1.5$  g/L), and the great biomass productivity is recorded at 116 mg/L/h.

(B) Effects of the light intensity, light path, and the biomass concentration on the CO<sub>2</sub> fixation rate of TCL-1

- (1) The carbon content reaches and maintains at about 40% when the biomass concentration is greater than 3 g/L (Fig. 1b).
- (2) The magnitude of enhancing the CO<sub>2</sub> fixation rate by decreasing the light path is much larger than the magnitude by enhancing the light intensity. Furthermore, the greatest CO<sub>2</sub> fixation rate is recorded at about 170 mg/L/h in the 1.5 cm light path photobioreactor while the light intensity is 1,000  $\mu\text{E m}^{-2} \text{s}^{-1}$  (Fig. 1c).

(C) Effects of the light intensity, light path, and the biomass concentration on the bioethanol production potential of TCL-1

- (1) The optimum carbohydrate productivity under the 1.5 cm light path photobioreactor (65 and 67 mg/L/h under light intensity of 2,000 and 1,000  $\mu\text{E m}^{-2} \text{s}^{-1}$ , respectively) is significantly higher and more stable than that under the 3.0 cm light path photobioreactor (54 mg/L/h) (Fig. 1d).