Study on Fixation of Carbon Dioxide by Microalgae in Basic Cultures

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ABSTRACT

A microalgal strain which is able to grow under basic conditions was screened from pond water. This strain was then cultivated in media containing sodium bicarbonate or sodium carbonate to simulate the solutions from alkaline absorption proussls for carbon dioxide. Batch cultivations were used to investigate the effects of pH and total carbonate ion concentration on the grow of this strain and the utiligation of carbon source. Bath experiments e=were conducted under a light intensity of 10000 lux with initial pH of7.3, 8, 9 and 10, and with initial total carbonate in concentrations of 0.036 and 0.072 M. With the initial total carbon ion concentration of 0.036 M, the highest utiligation percentage of carbon source was accurred in the cufture with initial pH of 9, and the average daily consumption rate of carbon was 145.63 mg of CO2 per day. The average daily consumption rate of carbon souru was 36.37 mg of CO2 per day in the culture with initial pH of 10. The highest biomass concentration of 0.831 g was also obtained in the culture with initial pH of 9. With the initial total carbonate ion concentration of 0.072 M , the highest average daily consumption rate of carbon source was 286.35 ng of CO2 per day, in the culture with initial pH of 8. The lowest average daily consumption rate was 133.20 mg of CO2 per day with initial pH of 9. The highest biomass concentration of 0.865 g was obtained in the culture with initial pH of 7.

Keywords : carbon dioxide ; sodium carbonate ; consumption

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REFERENCES

1. 李文哲，2006，以高溫高鹼環境培養微藻固定模擬吸收塔之吸收液中二氧化碳之研究，成功大學環境工程學系碩士論文，台南。 2. 吳俊宗，1998，海洋初級生產力，國際海洋年系列報導。 3. 林榮芳、黃檀溪，2002，比較耐熱性小球藻異營生長之特性，師大學報:數位科技類，47（1），pp.31-40。 4. 林義璋，2008，以NaHCO3為碳源連續培養Tetraselmis Chui，大葉大學環境工程學系碩士論文，彰化。 5. 徐恆文，2007，二氧化碳的捕獲與分離，科學發展月刊，413期，pp.24 – 27。 6. 張睿昇，2003，台灣沿海的藻類，生物多樣性研習營，pp.1 – 7。 7. 張國軒，2009，以回流式光生化反應器探討碳酸氫鈉濃度及藻液循環量對周氏扁藻生長之影響，大葉大學環境工程學系碩士論文，彰化。 8. 陳飛鵬，2008，以NaHCO3為碳源連續培養Tetraselmis Chui，大葉大學環境工程學系碩士論文，彰化。 9. 黃大仁，2003，二氧化碳減量技術，工業污染防治月刊，88期，pp.123 – 134。 10. 葉俊良，2006，在光生化反應器中以二階段策略培養微藻生產油脂之研究，成功大學化學工程學系碩士論文，台南。 11. 農業工程研究中心，2005，水中鹼度檢測作業方法標準作業程序，灌溉水質複驗技術手冊。 12. 廖得玲，2002，微藻基因分析與刑事鑑識應用之探討，中山大學海洋生物研究所碩士論文，高雄。 13. 鄭俊明、劉清雲，微藻產業，科學發展月刊，415期，pp.34 – 40。 14. 潘建成，2007，二氧化碳分離與回收技術。 15. 謝惠南，2009，以連續式光生化反應器探討光強度及碳酸氫鈉 濃度對周氏扁藻生長之影響，大葉大學環境工程學系碩士論 文，彰化。 16. 顧洋，2005，危機就是轉機，二氧化碳的處理技術簡介，能源 報導，2005年10月，pp. 5 – 7。 17. 蘇美惠，1999，餌料生物之培養與利用，台灣水產

試驗所，台北。 18.Apt, K.E, Behrens, P.W,（1999） Commercial devdlopments in microalgae biotechnology. J. Phycol. 35（2）,pp.215-226. 19. Becker, E.W,（1994） Microalgae: biotechnology and microbiology. Cambridge University Press. UK. ,pp.l. 20. Brown, P., (1996), “ Global Warming ”, Blandford London, pp.235. 21. Carvalho, AP., Malcata, FX.（2005） Optimization of omega-3 fatty acid production by microalgae: Crossover effects of CO2 and light intensity under batch and continuous cultivation modes. Mar. Biotechnol. 7（4）,pp.381-388. 22. Chen, F. (1996) High cell density culture of microalgae in heterotrophic growth. Trends Biotechnol., 14(11): 421-426. 23. Endo, T.,Schreiber, U., Asada, K.（1995） Supperssion of quantum yield of photosystem-II by hyperosmotic stress in Chlamydomonas-reinhardtii. Plant Cell Physiol. 36（7）,pp.1253-1258. 24. Fernandez, F.G.A., Sevilla, J.M.F., Perez, J.A.S., E.M., Chisti, Y.（2001） Chen, F.（1996） High cell density culture of microalgae in heterotrophic growth. Trends Biotechnol. 14（11）,pp，421-426. 25. Grima, E.M., Belarbi, E.H., Fernanedz, F.G.A., Medina, A.R., Caisti, Y.（2003） Recovery of micoralgal biomass and metabolites: process options and economics. Biotechnol. Adv. 20（7-8）,pp.491-515. 26. Hoshida, H.,Ohira, T; Minematsu, A., Akada, R., Nishizawa, Y.（2005） Accumulation of eicosspentaenoic acid in Nannochloropsis sp. In response to elevated CO2 concentrations. J.Appl. Phycol. 17（1）,pp. 29-34. 27. Hu, Q., Guterman, H., Richmond, A., (1996) A flat inclined modular photobioreactor for outdoor mass cultivation of photoautotrophs. Biotechnol. Bioeng., 51(1),pp. 51-60. 28. Jeong, M.I.L., Gillis, J.M., Hwang, J.Y.（2003） Carbon dioxide mitigation by microalgal photosynthesis. Bull. Korean Chem. Soc. 24（12）,pp. 1763-1766. 29. Laliberte, G., Delanoue, J.（1993） Autotrophic, heterotrophic, and mixotrophic growth of chlamydomonas-humicola（chlorophyceae） on acetate. J. Phycol. 29（5）,pp.612-620. 30. Maruyama I., Nakamura T., Matsubyayashi T., Ando Y., Maeda T.（1986）Identifi-cation of the alga known as marine chlorella as a member of the Eustigmato-pheceae. Japanese Journal of Phycology 31. Masojidek, J., Koblizek, M., Torzillo, G. (2004) Photosynthesis in microalgae. In: Richmond A, editor. Handbook of Microalgal Culture: Biotechnology and Applied Phycology. Blackwell Science. UK. ,pp.20-33. 32. Pulz, O. (2001) Photobioreactors: production systems for phototrophic microorganisms. Appl. Microbiol. Biotechnol., 57(3),pp.287-293. 33. Renaud,S.M., Thinh,L.V., Lambrinidis,G.,Parry,DL,（2002）Effect of temperature on growth, chemical composition and fatty acid composition of tropical Australian microalgae grown in batch cultures. Aquaculture 211（1-4）,pp. 195-214. 34. Richmond,AE.（1986）Microalgaculture. Crit. Rev. Biotechnol. 4（4）,pp. 369-438. 35. Rocha, J.M.S., Garcia, J.E.C., Henrigues, M.H.F.,（2003） Growth aspects of the marine microalga Nannochloropsis gaditana. Biomol. Eng. 20（4-6）,pp.237-242. 36. Rubio, F.C., Fern?鴨dez, F.A.G., P?臆ez, J.A.S., Camacho, FG., Grima, E.M. (1999) Prediction of Dissolved Oxygen and Carbon Dioxide Concentration Profiles in Tubular Photobioreactors for Microalgal Culture, Biotechnol Bioeng, 62,pp.71-86. 37. Sato, T., Usui, S., Tsuchiya, Y. and Kondo, Y. (2006) Invention of outdoor closed type photobioreactor for microalgae. Energy Conv. Manag., 47(6): 791-799. 38. Sobczuk, T.M., Camacho, F.G., Rubio, FC., Fernandez, F.G.A., Grima, E.M.（2000） Carbon dioxide uptake efficiency by outdoor microalgal cultures in tubular airlift photobioreactors. Biotechnol. Bioeng. 67（4）,pp. 465-475. 39. Terry, K.L., Raymond, L.P.(1985) system design for the autotrophic production of microalgae, Enzyme Microb. Technol. 7（10）,pp. 474-487. 40. Turpin, D.H.（1991） Effect of inorganic N availability on algal photosynthesis and carbon metabolism. J. Phycol. 27（1）:14-20. 41. Wen, Z.Y., Chen, F.（2003） Heterotrophic production of eicosapentaenoic acid by microalgae. Biotechnol. Adv. 21（4）,pp.273-294. 42. Zittelli, G.C., Pastorelli, R., Tredici, M.R.（2000） A Modular Flat Panel Photobioreactor（MFPP） for indoor mass cultivation of Nannochloropsis sp. under artificial illumination. J. Appl. Phycol.12（3-5）,pp.521-526.