POTENTIAL CARBON DIOXIDE FIXATION BY MARINE MICROALGAE *NANNOCHLORIS ATOMUS*

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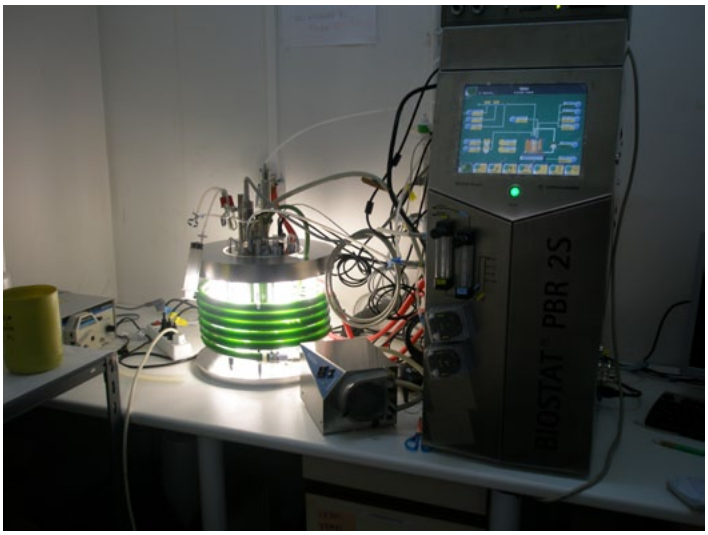
Abstract -" The increase in the concentration of atmospheric carbon dioxide is considered to be one of the main causes of global warming. Microalgae can contribute to the reduction of atmospheric carbon dioxide by using this gas as carbon source. We cultivated Nannochloris atomus in a helical tubular photobioreactor. Potential carbon dioxide fixation was compared under different growth conditions.

"Keywords-" Photobioreactor, carbon dioxide, microalgae.

A variety of studies investigating different strategies for CO2 sequestration have been conducted since the 1990s, of which biological methods, in particular using microalgal biofixation in photobioreactors, have recently gained renewed interest [1]. The cultivation system consisted of a BIOSTAT®PBR 2S photobioreactor with a working volume of 3L (fig. 1)



"Fig. 1." Photobioreactor system.

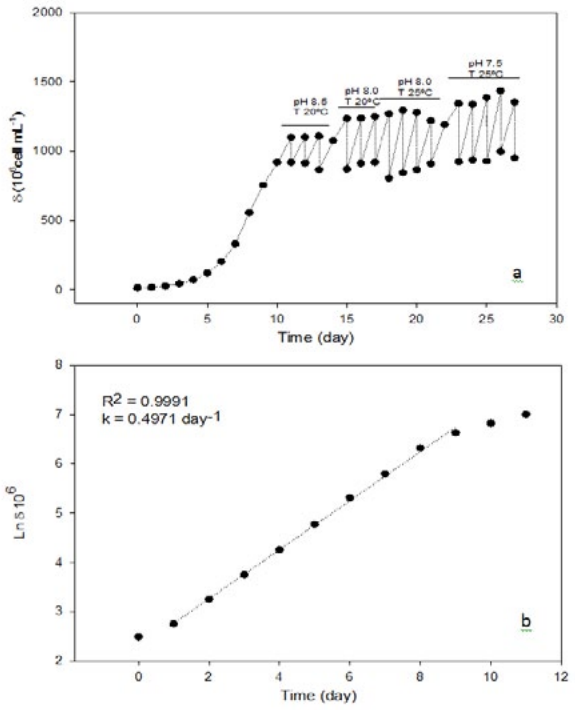
The strain belongs to a stock culture kept in our laboratory. The culture medium was a modified F/2 medium made in filtered sterilized natural seawater, without nutrient limitation. The cells were continuously aerated at a rate of 300 mL min–1. The growth medium was controlled at different temperatures by the recycled water from a thermostatic bath, The mixing was driven by a peristaltic pump. Illumination of culture was provided by eight fluorescent lamps with 1200 lm per lamp. For control and measurement of pH, a sensor was used and the pH was controlled by automatic injection of CO2. The cultivation vessel was coupled with the sensor for the CO2 measurement in the inlet and outlet. In the inlet, CO2 was monitored by a rotameter, while in the outlet, total flow was monitored by an infrared CO2 gas analyzer (LI-6262 CO2/H2O Analyzer, Nebraska, USA).
The maximum cellular density achieved in the experiment was of 1430• 106 cells mL-1, with a cell mass of 2900 mg L-1. Cell density values and linear regression were used to calculate the growth rate (k, d-1) during the exponential phase, obtaining a value of 0.4971 d-1 (Fig.2). Potential fixation was calculated as: Λ= m f k δ, where Λ represents the CO2 fixation rate (mmol C d-1 L -1), m represents cellular mass (g cell-1), f represents the carbon fraction, k represents the growth rate, and δ represents cell density (cell L-1). We calculated the potential fixation for the different averaged cell densities reached in each phase, obtaining a value of 51.3 mmol C d-1L-1 (pH 8.5 and temperature 20ºC), 57.2 mmol C d-1L-1, (pH 8.0 and temperature 20ºC), 58.8 mmol C d-1L-1, (pH 8.0 and temperature 25ºC), 62.2 mmol C d-1L-1(pH 7.5 and temperature 20ºC).

The maximum potential fixation such as cell density are reached with lower pH and a high temperature, due that Nannochloris species have a greater capacity for CO2 utilization rather than HCO3- [2].

AKNOWLEDGEMENTS
This study was supported by the Research Projects CICYT - CTM2008-04807 and PO7-RNM-03197.

REFERENCES

[1] Fan, L-H., Zhang, Y-T., Chen, H-L, 2008. Evaluation of a membrane-spargerd helical tubular photobioreactor for carbon dioxide biofixation by Chlorella vulgaris. Journal of Membrane Science. 325: 336-345.
[2] Huertas, E. I. and Lubián, L. M., 1998. Comparative study of disolved inorganic carbón utilization and photosynthetic responses in Nannochloris (Chlorophyceae) and Nannochloropsis (Eustigmatophyceae) species. Canadian Journal of Botany. 76: 1104-1108.



"Fig. 2." (a) Growth curve of Nannochloris atomus when submitted to different conditions of temperature and pH. (b) Linearization of the exponential growth phase for calculating the growth rate.