EFFECT OF THE LIGHT INTENSITY ON THE DYNAMIC OXYGEN PRODUCTION BY THE MICROALGAE *SCENEDESMUS OBTUSIUSCULUS*

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Introduction. The potential of microalgae for production of various metabolites, biofuels and in environmental bioremediation is recognized. One of the key factors that affect the performance of microalgal cultivation systems is the availability of light as it influences the photosynthetic activity and consequently the biomass productivity [1]. Produced oxygen has been used to indicate the photosynthetic activity and its rapid response, at different irradiance regimes, in a time scale of minutes could provide information about photoacclimation of the photosystem II [2]. In general, the understanding and quantification of the dynamic light dependence of microalgal activity is important to design an efficient photobioreactor, predicting process performance, and optimizing operating conditions [3]. The aim of this work was to study the dynamic response of the photosynthetic activity by the microalgae *Scenedesmus obstusiusculus* at different light intensities in an airlift-photobioreactor.

Methods. *Scenedesmus obtusiusculus* [4] was cultivated in an internal-loop acrylic airlift photobioreactor. The outer column had a diameter of 12.7 cm and a height of 150 cm; the diameter of the inner column was 8.9 cm it was operated in batch mode with 17.6 L of BG-11 mineral medium and continuously exposed to a light intensity of 117µmol m^{-2} s^{-1}. The gas phase with 3.8% CO_2 was supplied at 3.5 L/min, the irradiances was varied from 117 to 505 µmol m^{-2} s^{-1} in light step-changes (Table1) for periods of 30 minutes. A data acquisition system was implemented for logging: dissolved oxygen, temperature, light intensity, pH, dissolved CO_2 and in gas phase. The dynamic experiments of the photosynthetic activity were followed through dissolved oxygen measurements and oxygen production rate, r_{O2}, for each experiment was calculated by:

$$r_{O_2} = K_L a_{O_2} \left(C_{O2,i} - C_{O2,s} \right) \qquad (1)$$

K_La_{O2} was previously determined as 12.3 h^{-1}, $C_{O2,s}$ is the oxygen saturation concentration (6.4 mg/L) and $C_{O2,I}$ is the oxygen concentration for each pseudo-steady state. Dynamic experiments were carried out at different operation times when biomass concentrations were between 0.3 and 1.7 g/L.

Results. Figure 1 shows the dynamic behavior of oxygen concentration and the period of photoacclimation of the microalgae *Scenedesmus obtusiusculus* in response to the dynamic adaptation of the photosynthetic apparatus to changes in irradiance.

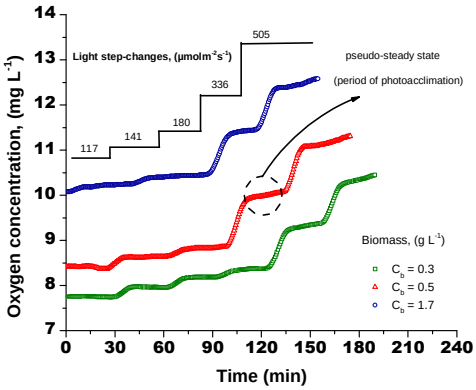

Fig.1 Dynamic response of the oxygen during the perturbations in light intensity.

Table 1 shows the specific oxygen production rate in pseudo-stationary state; these values increased in non-linear form with respect to the light intensity and it diminished as biomass concentration increased due to the light attenuation. For an incident light of 336 µmol m^{-2} s^{-1} the irradiance in the core diminished to 40 µmol m^{-2} s^{-1} for biomass concentrations between 0.1 and 0.5 g/L.

Table 1. Specific oxygen production rates at different irradiances and biomass

	r_{O2} (mg_{O2}/g_b-h)	r_{O2} (mg_{O2}/g_b-h)	r_{O2} (mg_{O2}/g_b-h)
Light intensity	C_b (0.3 g/L)	C_b (0.5 g/L)	C_b (1.7 g/L)
141	71.7	57.8	27.8
180	79.5	63.1	29.5
336	119.3	93.8	36.6
505	163	126	45

Conclusions. The results obtained in the dynamic experiments through determinations of the oxygen production rate provide an easy and rapid alternative for the *in-situ* evaluation of the photosynthetic activity at different biomass concentrations. It can contribute to the design of photobioreactors, and establish mathematical models to control design and operating conditions that could increase the global process efficiency in photobioreactors.

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