OUTDOOR CULTIVATION MICROALGAE *Scenedesmus obtusiusculus* FOR BIOMASS PRODUCTION

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Introduction. In recent years, research into new energy sources renewable and environmentally friendly has taken a fresh impulse. The microalgal biomass is considered a promising alternative for biofuel production and CO_2 mitigation. However, microalgal biofuels are not economically viable yet. In order to reduce the operating costs, cultivation in outdoors is an option for saving energy costs. However, operation conditions such as high temperature and light intensity could limit the biomass growth (1). Therefore it is necessary to work with microalgae able to grow at high temperatures and light intensities.

The aim of this study was to evaluate the seasonal variability in growth of the microalgae, *Scenedesmus obtusiusculus*, cultivated in outdoors.

Methods. The study was conducted in an external-tube airlift photobioreactor with a working volume of 34.5 L, an air flow of 5L min^{-1} and 1% CO_2. The mineral medium was BG-11 and the initial concentration of *S. obtusiusculus* (2) was 0.1 g L^{-1}. The experiments were performed at the Universidad Autónoma Metropolitana-Iztapalapa, located at 19°21'41 "N99 ° 04'22" W during the four seasons. The duration of each experiment was 17 days. The biomass concentration was periodically measured and the solar irradiation, temperatures (liquid and environmet) were logged during the experiments.

Results. Table 1 shows the maximum observed biomass (X_{max}), the maximum productivity (P_{max}), the consumed CO_2 (PCO_2) and specific growth rate (μ_{max}) during the different seasons. As it can be noticed, during spring the microalga exhibit the best performance although the medium (T_{medium}) and environment ($T_{enviroment}$) temperatures were higher than those presented in the other seasons. Photoinhibition and photoacclimatation (4), were also observed in spring (see Figure 1), during three days, chlorophyll concentration was lower than values observed in the previous days (data not shown). The high temperatures, light intensity and the low biomass concentration cause these phenomena. At day 7, growth was reestablished and the highest biomass concentration (5 g L^{-1}) was achieved.

S. obtusiusculus withstands temperatures in a wide range from below 10 to above 40 °C in the different seasons. This temperature range is wider than intervals reported for other oleaginous microalgal species such as *Nannochloropsis oculata*, *Chlorella* and *Scenedesmus* sp. LX1(3).

The growth parameters were similar during summer and autumn, but in winter the growth parameters were lower because of the low temperatures occurred in this period.

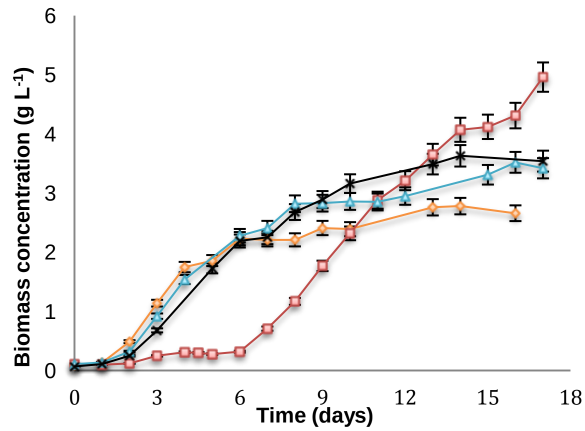

Fig.1 Biomass productivity in seasonal periods. Winter (◊), spring (□), summer (Δ), and autumn (X).

Table 1. Growth parameters and environmental variables obtained by *S. obtusiusculus* in different seasonal periods.

Season	Winter	Spring	Summer	Autumn
X_{max}(g L^{-1})	2.76	5.13	3.31	3.50
P_{max}(g L^{-1} d^{-1})	0.19	0.29	0.21	0.27
μ_{max}(d^{-1})	0.24	0.24	0.21	0.22
P_{CO2}(g L^{-1} d^{-1})	0.34	0.50	0.37	0.47
I_{max}(µmol $m^{-2}s^{-1}$)	1757	1719	1677	1717
$T_{enviroment}$ (°C)	10-31	14-33	13-30	10-36
T_{medium} (°C)	9-40	13-44	10-36	9-38

Conclusions. *S. obtusiusculus* has a good productivity, compared with an others microalgae (3) which are inhibited at high temperatures. *S. obtusiusculus* also presented acclimation to environmental conditions, suggesting that environmental factors, that caused some stress in the microalga, promoting increased productivity.

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