Effect of light irradiance on *Chlorella sorokiniana* growth and biochemical composition in an ultra-flat photobioreactors

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Microalgal cultures are sources of several interesting biomolecules representing renewable building blocks for materials and chemicals very required in our era. The current bottlenecks of microalgal cultures are the low biomass concentration and productivity which result in large cultivation and harvesting costs [1]. One of the main problem in microalgal cultivation is the light availability along the optical path of the adopted culture system [2], [3]. In order to increase light availability and then photosynthetic efficiency and biomass production, an ultra-flat photobioreactor (UFP) was designed and operated. UFP is characterized by a thickness of 3 mm and allow to obtain up to 20 g L^{-1} of microalgal biomass in less than 100 h. In this study we investigated the effect of light irradiance in UFP on *Chlorella sorokiniana* growth, biochemical composition and photosynthetic efficiency. Batch growth were performed out at different continuous light irradiance. To prevent any other limitations the inorganic nutrients were continuously added during the growth. And CO2 concentration was adjusted during the growth in order to maintain the pH value at 7.

The screening at light irradiance from 50 to 1000 µmol m^{-2} s^{-1} resulted in: 1) the maximum biomass concentration of 24 g L^{-1} reached was at light irradiance of 300 µmol m^{-2} s^{-1} 2) the maximum volumetric productivity of 0.34 kg m^{-3} h^{-1}, at 750 µmol m^{-2} s^{-1}, 3) the specific growth rate increased with the light irradiance reaching 0.1 h^{-1} at 1000 µmol m^{-2} s^{-1}. In addition carbohydrates and starch content of the biomass reach a maximum of 29 and 40 %DW at 300 µmol m^{-2} s^{-1} then, its content decrease in favor of proteins synthesis for higher light irradiances. Indeed a better light availability could be supposed to lead to a faster growth coupled with rapid protein synthesis; so more energy was spent for cells reproduction than stored in starch accumulation. Lipids content remains almost constant (10-20%DW) Reduced optical path and high light irradiance seems to have no deleterious effect on *C. sorokiniana* photosynthetic activity.

[1] Ruiz J., Olivieri G., De Vrre J., Bosma R., Willems P., Reith J. H., Eppink M. H. M., Wijffels, R.H., Barbosa, M.J. Towards industrial products from microalgae. Energy and Environmental Science. 2016, 9 (10), 3036-3043

[2] Qiang H., Richmond A., Productivity and photosynthetic efficiency of *Spirulina platensis* as affected by light intensity, algal density and rate of mixing in a flat plate photobioreactor. Journal of Applied Phycology , 1996, .8, 139-145.

[3] Soulie`s A., Legrand J., Marec H., Pruvost J. Investigation and Modeling of the Effects of Light Spectrum and Incident Angle on the Growth of *Chlorella vulgaris* in Photobioreactors. American Institute of Chemical Engineers. 2016, DOI 10.1002/btpr.2244.