Evaluation of Cultivation Parameters Effects on Pigments and Carbohydrates Production by Arthrospira platensis

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Introduction: Arthrospira platensis is a microalga of great pharmacological and alimentary value due to rapid growth and high productivity of several compounds as proteins, carbohydrates, carotenoids and the phycocyanin pigment, which have a broad spectrum of biological activities.¹,² It is known that photon flux density (PFD) and nitrate concentration may cause a metabolic stress and affect the pigments and carbohydrate production by A. platensis.²,³ However, studies of the effect of the variations of PFD and nitrate concentrations in simultaneous carbohydrate and pigments production were still not carried out. Objective: To evaluate the production of pigments and carbohydrates in different cultivation conditions of PFD and nitrate concentration in A. platensis. Methodology: A. platensis was cultivated in Zarrouk medium with different NaNO₃ concentrations (0.25, 1.125 and 2 g.L⁻¹) in bottles (4 L) at 32°C under constant aeration, and under white LED of different PFD (200, 600 and 1000 μEm⁻²s⁻¹). The carotenoids extraction and quantification was performed according to the methods performed by Lima et al.² The phycobiliproteins were extracted by the freezing/thawing method and quantified using the equation defined by Bennett and Bogorad (1973).⁴ Carbohydrate quantification was carried out according to Dubois et al. (1956).⁵ Results and Discussion: The greatest carbohydrate concentration (131.63 ± 10.85 mg.L⁻¹) was observed on 0.25 g.L⁻¹ and 1000 μEm⁻²s⁻¹, the lowest NaNO₃ concentration and the highest PFD value, respectively. Lowest nitrogen concentrations can affect the carbohydrate production, since in the starved nitrogen condition metabolism will be directed to the production of reserve compounds such as carbohydrates. Previous studies have reported that phycocyanin production is more effective at lower PFD; this result was also observed in this study, as the lowest PFD of 200 μEm⁻²s⁻¹ showed to be the most effective in the production of phycocyanin (82.52 ± 1.01 mg/g). In addition, the NaNO₃ concentration of 1.125 g.L⁻¹ was the most effective at this PFD for phycocyanin production, showing that there is a minimum of NaNO₃ concentration to reach a certain phycocyanin content and an additional quantity of NaNO₃ does not influence this production. The quantification of total carotenoids showed that high PFDs (600 and 1000 μEm⁻²s⁻¹) and the low concentration of NaNO₃ (0.25 g.L⁻¹) were the best condition to produce these substances (0.074 ± 2.10 mg.g⁻¹). Conclusion: The lower PFD and median NaNO₃ concentration stimulates the phycocyanin biosynthesis. On the other hand, the high PFD and low NaNO₃ concentration increases the carotenoids and carbohydrates production. References: ¹Cavalcanti et al., Produção e Controle de Produtos Naturais, Ed. Atena, cap. 6, 2018 ²Lima et al., Influence of spectral light quality on the pigment concentrations and biomass productivity of Arthrospira platensis, Algal Research, 31, 157-166, 2018. ³Sujatha & Nagarajan., Effect of different nitrogen concentrations on the biomass and biochemical constituents of Spirulina platensis [Geitler], Asian Journal of Bio Science, 8,(2), 245-247, 2013. ⁴Cavalcanti et al. Production of Pigments with Commercial Interest Obtained from Arthrospira platensis grown in two different LEDS, 42º Reunião Anual da Sociedade Brasileira de Química, 2019. ⁵Bennett & Bogorad, Complementary chromatic adaptation in a filamentous blue-green alga, J Cell Biology 58(2), 419-435, 1973. ⁶Dubois, M., Gilles K. A., Hamilton, J. K., Rebers, P. A., Smith, F. Colorimetric Method for Determination of Sugars and Related Substances. Analytical Chemistry 28 (3), 350-356, 1956.