

Supercritical carbon dioxide extraction of biological compounds from microalgae

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Microalgae are eukaryotic, photosynthetic, unicellular microorganisms that present a great genetic diversity. These microorganisms produce several biological compounds that are important in the nutraceutical and pharmaceutical industries, such as hydrocarbons, carotenoids, vitamins, polyunsaturated fatty acids, etc [1].

Supercritical fluid extraction (SFE) of biological compounds from microalgae has some advantages over the conventional solvent extraction methods, because the compounds can be obtained without contamination by the organic solvent and thermal degradation [2]. On the other hand, it is possible a high efficiency of the extraction and the selectivity for certain compounds is more easily achieved with SFE than with organic solvent extraction. Moreover, supercritical carbon dioxide extraction has also the advantage of using a non-toxic, non-flammable and cheap solvent.

Supercritical fluid extraction studies of biological compounds from several microalgae, such as *Botryococcus brauni*, *Chlorella vulgaris*, *Dunaliella salina*, *Haematococcus pluvialis* and *Arthrospira (Spirulina) maxima* have been carried out in our laboratories [3,4,5,6,7]. A semi-continuous laboratorial-scale supercritical fluid extraction apparatus, which allows working in the temperatures range of 40-80 °C and pressures up to 400 bar, was used to perform all studies [8]. The extracted compounds were identified and quantified off-line by HPLC, GC and UV/Visible spectrophotometry. The effect of temperature, pressure and solvent flow-rate, together with the use of co-solvent and pre-treatment of the microalgae biomass, was assessed in these extraction studies.

The aim of this work is to present an overview of the most important results achieved during the supercritical carbon dioxide extraction of biological compounds from the several microalgae studied with special emphasis on the effect of the pre-treatment of the biomass and the use of entrainers in the extraction of carotenoids.

References

- [1] Z. Cohen, Chemical from Microalgae, Taylor & Francis, London, 1999.
- [2] T. Bruno, C.A.N. Castro, J.F. Hammel, A.M.F. Palavra, in J.F. Kennedy, J.M.S. Cabral (Eds), Supercritical Fluid Extraction of Biological Products. Recovery Processes for Biological Materials, J. Wiley & Sons, Chichester; 1993.
- [3] – Mendes, R. L., Fernandes, H. L., Coelho, J. A. P., Cabral, J. M. S., Palavra, A. M. F., Novais, J. M., Supercritical carbon dioxide extraction of hydrocarbons from the microalgae *Botryococcus braunii*, J. of Applied Phycology, 6 (1994), p.289-293.

- [4] – L. Gouveia, Beatriz P. Nobre, Filipa M. Marcelo, S. Mrejen, M. T. Cardoso, Antonio F. Palavra, Rui L. Mendes, " Food Functional oil coloured by pigments extracted from microalga with supercritical CO₂", Food Chemistry, 101 (2), 2007, p.717-723
- [5] – Beatriz Nobre , Filipa Marcelo, Renata Passos, Luis Beirão; António Palavra, Luísa Gouveia, Rui Mendes, Supercritical Carbon Dioxide Extraction of Astaxanthin and other Carotenoids from the Microalga *Haematococcus pluvialis*, Eur. Food Res, Technol., 223, 2006, p.787-790.
- [6] – Rui L. Mendes, Beatriz P. Nobre, Miguel T. Cardoso, Ana P. Pereira, António F. Palavra, "Supercritical Carbon Dioxide Extraction of Compounds with Pharmaceutical Importance from Microalgae", Inorganic Chimica Acta, 356, 2003, p.328-334.
- [7] – Mendes, R. L., Reis, A., Palavra, A. M. F., Supercritical CO₂ extraction of γ -linolenic acid and other lipids from *Arthrospira (Spirulina) maxima*: comparison with organic solvent extraction, Food Chem. 9(2006), p.57-63.
- [8] – R. L. Mendes, J. P. Coelho, H. L. Fernandes, I. J. Marrucho, J. M. S. Cabral, J. M. Novais, A. F. Palavra, Applications of supercritical CO₂ extraction to Microalgae and Plants, J. Chem. Tech. Biotechnol., 62 (1995), 53.