Physical and chemical methodologies for extraction of carotenoids from different dried microalgae biomass

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Introduction

Microalgae are a natural resource with great potential for the isolation of natural substances with health benefits to humans. Their unique nutritional profile, which varies considerably depending on the species, place and season of harvest, rises industrial interest for the elaboration of extracts rich in bioactive compounds [1, 2]. In addition, microalgae exhibit numerous advantages, such as high growth rates and biomass production, the possibility of process optimization and also commercial and sustainability advantages [3-4].

Microalgae offer an opportunity for the development of innovative products of high value at the nutraceutical, pharmaceutical and cosmetic levels.

Objectives

In the present work, the total carotenoids was evaluated in different microalgae dried biomasses after extraction by different methods, physical and chemical, in order to select the most adequate methodology for extraction yield maximization.

Methods

The microalgae biomass under study was supplied by A4F. The dried biomasses were submitted to different extraction methods in order to find out which process is the most efficient to obtain compounds of interest, and, also, to perceive which methodology can be easily scaled up to the industrial level. The extracts obtained by using each method underwent spectrophotometric and, afterwards, HPLC analysis to quantify their carotenoid profile.

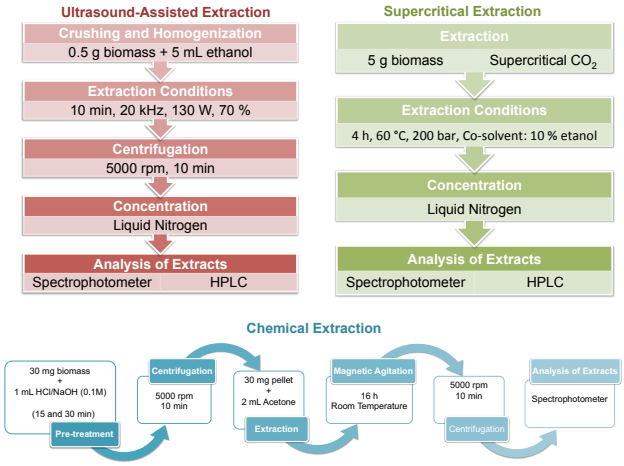

Figure 1. Extraction methodologies.

- ✓ The total carotenoid content (TCC) was determined in the different extracts by using absorbance readings at 470, 644 and 661 nm.
- ✓ In addition, the carotenoid profile was obtained through HPLC analysis for each sample. The contents of β-carotene, astaxanthin and zeaxanthin were quantified (data not shown).

Results

Total Carotenoid Content (TCC)

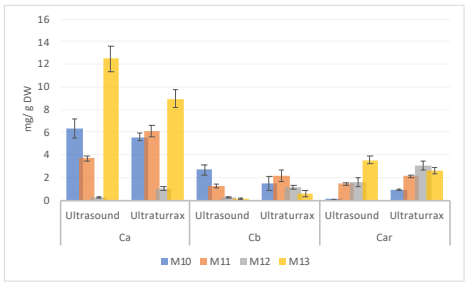

Figure 2. Determination of chlorophylls *a* (Ca) and *b* (Cb) and total carotenoids (Car) in the microalgae biomasses 10 - 13 after the extraction processes with ultrasound probe and ultraturrax.

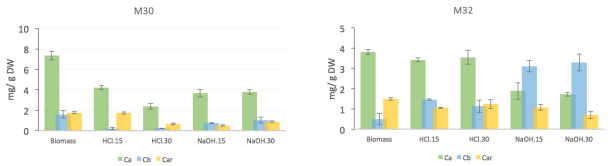

Figure 3. Measurement of chlorophylls *a* (Ca) and *b* (Cb) and total carotenoids (Car) from microalgae biomasses 30 and 32 after chemical pre-treatment and extraction.

- ○ All extracts proved to be excellent sources of natural carotenoid compounds.
- ○ In general, the physical extraction proved to be more efficient in recovering carotenoids from biomass.
- ○ The acid/alkali pre-treatment did not present much advantage.

Conclusions

The studied extracts can be considered a promising natural source of carotenoids, such as β-carotene, astaxanthin and zeaxanthin.

The methods studied showed to be promising for the extraction of total carotenoids from the microalgae biomasses. Among these, the extraction using ultrasound and ultraturrax presented better results.

Further research should be carried out in order to optimize these methodologies, as the extraction of bioactive compounds remains a major challenge in microalgae biotechnology.

Bibliography

1. Koyande, A. K., Chew, K. W., Rambabu, K., Tao, Y., Chu, D. T., & Show, P. L. (2019). Microalgae: A potential alternative to health supplementation for humans. *Food Science and Human Wellness*, *8*(1), 16-24.
2. Khanra, S., Mondal, M., Halder, G., Tiwari, O. N., Gayen, K., & Bhowmick, T. K. (2018). Downstream processing of microalgae for pigments, protein and carbohydrate in industrial application: A review. *Food and bioproducts processing*, *110*, 60-84.
3. Günerken, E., et al., Cell disruption for microalgae biorefineries. *Biotechnology Advances*, 2015. 33(2): p. 243-260.
4. Gong, M. and A. Bassi, Carotenoids from microalgae: A review of recent developments. *Biotechnology Advances*, 2016. 34(8): p. 1396-1412.

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