

Practical Experiences in the Development of a Lab-Scale Process for the Production and Recovery of Fucoxanthin

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Abstract : Fucoxanthin is a carotenoid that exerts multiple beneficial effects on human health, including antioxidant, anti-cancer, antidiabetic and anti-obesity activity; making the development of a whole process for its production and recovery an important contribution. In this work, the lab-scale production and purification of fucoxanthin in *Isocrhysis galbana* have been studied. In batch cultures, low light intensities (13.5 $\mu\text{mol}/\text{m}^2\text{s}$) and bubble agitation were the best conditions for production of the carotenoid with product yields of up to 0.143 mg/g. After fucoxanthin ethanolic extraction from biomass and hexane partition, further recovery and purification of the carotenoid has been accomplished by means of alcohol - salt Aqueous Two-Phase System (ATPS) extraction followed by an ultrafiltration (UF) step. An ATPS comprised of ethanol and potassium phosphate (Volume Ratio (VR) =3; Tie-line Length (TLL) 60% w/w) presented a fucoxanthin recovery yield of $76.24 \pm 1.60\%$ among the studied systems and was able to remove $64.89 \pm 2.64\%$ of the carotenoid and chlorophyll pollutants. For UF, the addition of ethanol to the original recovered ethanolic ATPS stream to a final relation of 74.15% (w/w) resulted in a reduction of approximately 16% of the protein contents, increasing product purity with a recovery yield of about 63% of the compound in the permeate stream. Considering the production, extraction and primary recovery (ATPS and UF) steps, around a 45% global fucoxanthin recovery should be expected. Although other purification technologies, such as Centrifugal Partition Chromatography are able to obtain fucoxanthin recoveries of up to 83%, the process developed in the present work does not require large volumes of solvents or expensive equipment. Moreover, it has a potential for scale up to commercial scale and represents a cost-effective strategy when compared to traditional separation techniques like chromatography.

Keywords : aqueous two-phase systems, fucoxanthin, *Isocrhysis galbana*, microalgae, ultrafiltration

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