**Microalgae bio-products application for nutraceutical sector and cosmetics ingredients**

Casella Patrizia 1, Rimauro Juri1, Iovine Angela1,2, Mehariya Sanjeet1,2, Musmarra Dino2, Molino Antonio1,\*

*1 Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA),*

*Territorial and Production System Sustainability Department, CR Portici Piazzale Enrico Fermi, 1 - 80055,*

*Portici, Italy; 2 Department of Engineering, University of Campania “Luigi Vanvitelli”, Via Roma, 29 - 81031 Aversa, Italy*

*\*Corresponding author: antonio.molino@enea.it*

**Highlights**

* Cosmetics and nutraceutical ingredients as beta-carotene, astaxanthin, methyl linoleate, palmitate, and eicosapantenoic acid are produced from microalgae
* Their extraction by CO2-SFE was improved to obtain a good standard for nutraceutical and cosmetic application

**1. Introduction**

Microalgae are promising sources of high value compounds such as carotenoids, beta-carotene, lutein and astaxanthin, and fatty acids, (ω3 and ω6) that can find application in the growing sectors of nutraceuticals and cosmetics. Nutraceutical sector lies halfway between pharmaceuticals and nutrition, where natural compounds as vitamins, minerals, antioxidants are necessary as ingredients and active principles. Cosmetics industry is a very rich field that has also seen an ever-increasing trend in the demand for natural origin ingredients.

Among microalgae bio-products, beta-carotene is considered an excellent ingredient in nutraceuticals for its pro-vitamin A function, while astaxanthin in the form of oleoresin produced by the microalgae *Haematococcus pluvialis* is currently authorized as a novel food for its antioxidant properties [1]. In addition, the oils produced by the microalgae species *Ulkenia sp.* and *Schizochytrium sp.* have been authorised as novel foods and as sources of omega-3s (EPA and DHA). Lutein, on the other hand, is required as a supplement for its properties against degenerative macular disease. In cosmetic sector, ingredients as beta-carotene and lutein are used as colouring agents and skin conditioning, and polyunsaturated fatty acids (methyl linoleate and palmitate as both skin conditioning and emollient agents.

As part of the European project VALUEMAG (Valuable Products from Algae Using new Magnetic Cultivation and Extraction Techniques), the microalgae *Dunaliella salina*, *Scenedesmus almeriensis*, *Haematococcus pluvialis*, and *Nannochloropsis sp.* were selected for their ability to produce high value compounds such as beta-carotene, lutein and astaxanthin, and polyunsaturated fatty acids (PUFAs). The objective of the this work is to investigate the extraction of these bio-products by supercritical fluid extraction using CO2 as extraction fluids (CO2-SFE) and to evaluate the characteristics of extracted compounds compared to the characteristics of the products currently authorized as novel foods and ingredients in nutraceutical and cosmetic industry.

**2. Methods**

The complete methodological approach is shown in the figure 1. Microalgae were cultivated testing a six-meter height Soft Magnetic Cone (SOMAC), a magnetic conic photobioreactor. Supercritical fluid extraction (CO2-SFE) was tested varying temperature (°C), pressure (bar) and CO2 flow rate (g/min) to extract carotenoids and fatty acids polyunsaturated from *Dunaliella salina*, *Scenedesmus almeriensis*, *Haematococcus pluvialis*, and *Nannochloropsis sp.* freeze dried biomass. The extracts were characterized in term of carotenoids and PUFAs concentration following official methods. The characteristics of extracts were compared with the properties of authorized nutraceutical products. A cost analysis evaluation was finally carried out by a market analysis on the price of authorized products.



**Figure 1.** Methodological approach.

**3. Results and discussion**

Preliminary results have shown that beta-carotene, and astaxanthin can be extracted by CO2-SFE as the major compounds among carotenoids respectively from *D. salina* and *Haematococcus pluvialis.* The obtained extracts from CO2-SFE contained also an interesting fatty acids composition regarding compounds as methyl linoleate and palmitate in species such as *D. salina*, *Haematococcus pluvialis* for application as ingredients in cosmetics. In particular, palmitate constituted more than 50% of fatty acids methyl esters extracted from *D. salina* in different conditions.

The extraction was also tested on EPA content by CO2-SFE from *Nannochloropsis sp.* searching the best operative conditions to improve extraction yield given that EPA content higher than ≥ 10 % is required for nutraceutical EPA rich-oil from *Ulkenia sp.* and and *Schizochytrium sp*. microalgae.

**4. Conclusions**

Fatty acids and carotenoids composition of extracts obtained from microalgae using CO2-SFE demonstrated that are promising source for cosmetics and nutraceutical industry.

**References**

1. Commission Implementing Regulation (EU) 2017/2470 of 20 December 2017 establishing the Union list of novel foods in accordance with Regulation (EU) 2015/2283 of the European Parliament and of the Council on novel food.