Carotenoid extraction from microalgae cultivated in food industry effluents for the production of cosmeceuticals

I. Papachristou[1], C. Anagnostopoulou[1], K. N. Kontogiannopoulos[2], P. G. Kougias[1]

[1]Soil and Water Resources Institute, Hellenic Agricultural Organization – Dimitra, Thermi, 57001, Greece
[2]EcoResources PC, Kolchidos Str. 3, 55131, Thessaloniki, Greece
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Presenting author email: i.papachristou@swri.gr

The generation of wastewaters is an unfortunate consequence of most human activities, either domestic or commercial. The food-processing industry, in particular, is one of the largest producers of contaminated water bodies (Shrivastava *et al*, 2022). It is imperative that these wastewaters are treated and purified before either being reused or released into the environment in accordance with the tenets of circular economy and environmental protection.
Microalgae cultivation belongs to an emerging trend of technologies studied for this purpose. Microalgae are unicellular aquatic photosynthetic microorganisms characterized by their fast growth rates and diverse product output (Chisti, 2007). Depending on the cultivation conditions and growth stage, microalgae are proven to produce noteworthy amounts of bioproducts such as proteins, lipids and valuable pigments like carotenoids. Certain species, such as *Chlorella vulgaris* are remarkably resilient and able to grow in harsh conditions, including agro-industrial wastewaters (Pacheco *et al*, 2021). Microalgae require various nutrients like nitrogen or phosphorus for their growth, which are abundant and have to be removed from wastewaters of most types. Therefore, the opportunity for wastewater valorization with cogeneration of valuable microalgal biomass has attracted considerable research interest (Posadas *et al*, 2017).
In the BlueBioChain project, the valorization of wastewaters of different origins with microalgae cultivation will be evaluated. The pilot production of three high-market value products, a) cosmeceuticals, b) food additives and c) zero-waste aquaculture farms, will be demonstrated. The main topic of this presentation is the downstream processing of microalgae cultivated in effluents from the food industry for the production of cosmeceuticals and, more specifically, skin-care cream products.

Three different microalgae strains were used for this experiment, *Chlorella vulgaris* (*C. vulgaris*), *Scenedesmus sp.* (*S. sp*) and *Nannochloropsis oculata* (*N. oculata*). The microalgae were grown in a mixture of brewery wastewater, expired fruit juice and water. The carotenoid content of the produced biomass, the base content for the skin-care cream, was extracted and evaluated.
The carotenoids were extracted from freeze-dried microalgae with various organic solvents such as acetone and methanol. Design of experiment (DoE), a statistical approach to planning, executing and analyzing experimental trials, was applied to evaluate and select the experimental conditions. High-performance liquid chromatography (HPLC) was used to accurately determine the extract's carotenoid content.

The results will include the qualitative and quantitative carotenoid profile of the microalgae cultivated in wastewater. The experimental conditions and the organic solvent will be selected based on the DoE results. The above are expected to be ready by the time of final submission to the conference. If there is enough time, an assessment of the biological activity of the extracts is also planned.

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