A novel approach for the extraction, chemical characterization of carotenoids and lipids from Chlorella vulgaris

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Over the years, there has been a strong interest in the downstream processing of microalgae for the extraction of lipids and pigments as it is widely used in food formulations, cosmetics, and pharmaceuticals due to its rich fatty acid profile, and bioactive properties. The purpose of this study was to investigate the performance of novel extraction techniques for the recovery of pigmented lipids from *Chlorella vulgaris (C.v)*. The use of lipids obtained from *C.v* has been described as a promising alternative to fish oil (FO) due to the sufficient level of omega-3 fatty acid. Besides, the consumption of microalgae oil (MAO) ensures the intake of carotenoids, which gives MAO a nutritional benefit compared to FO.
Initially, sixteen novel extraction strategies were investigated for the extraction. Based on the extraction yield of carotenoids and lipids, six strategies (i.e., ultrasound-assisted extraction (UAE=1), pulsed electric field (PFAE=1), microwave-assisted extraction (MAE=1), ultrasound-microwave assisted extraction (UMAE=1), conventional-assisted extraction (CAE=1) and a control (CN=1)) were selected and explored further for fatty acid and carotenoid profiling, which was carried out using a gas chromatographic techniques.
The highest extraction of lipids (0.09 g/ g DW C.v) and carotenoids (4.5 µg/g DW C.v) was measured in samples treated with UAE (frequency-20 kHz; amplitude-100 %; time-10 min; temp four °C) compared to CAE where the level of lipids (0.02 g/ g DW C.v) and carotenoids (0.3 µg/g DW C.v) were significantly ($P < 0.0001$) low. The primary fatty acids identified were C16:0, C18:0, C18:1n9c, C18:2n6c, and C18:3n3.
Hence, the present study demonstrates a promising alternative to conventional lipid extraction from microalgae. The quantitative information on fatty acids and carotenoids can provide valuable data for process design at pilot and industrial scales.