Abstract

The steadily increasing demand for new drugs and food compounds based on natural products has recently turned the global attention to marine and aquacultural sources, such as macro-microalgae and their industrial processing wastes. In this project, carotenoids were chosen as a target family of pigments and supercritical fluid (SCF), sunflower oil (SF) and its methyl ester (ME-SF) were applied as feasible green extraction processes. Shrimp processing waste residues were chosen as one of the abundant marine by-products in Denmark. The highest carotenoid (astaxanthin (ASX)) content was achieved from wet shrimp waste using organic solvents (Hex:IPA). Among the green solvents, ME-SF followed by SF was observed as the best green solvents extracting 80% and 60% of the total ASX extracted by organic solvents, respectively. For both solvents, the highest ASX content using a short extraction time was achieved at the highest temperature, solvent to waste ratio, and stirrer speed while the waste particle size and moisture content were 0.6 mm and 86.8%, respectively. On the other hand, SCF without co-solvents had a low ASX extraction yield and prior to extraction step a drying process was required. Adding 5% co-solvents (EtOH, SF, and ME-SF) increased the ASX concentration in the extract. In addition, the carotenoid profile of nine red, four brown, and one green macroalgae from North Atlantic Sea were studied using HPLC and LC-MSMS analysis. Fucoxanthin was identified in all the species of algae studied contributing for approximately 20, 70, and 90% of the total identified carotenoids content in green, red, and brown algae, respectively. Among studied macroalgal species, extraction techniques were examined only on the macroalga *Ulva lactuca.* An increasing amount of carotenoids was observed when applying ME-SF at a higher ratio to fresh samples, while increasing the temperature up to 70°C resulted in degradation of the extracted carotenoids. Carrying out the SCFE processes at the highest applied temperature, pressure (55°C and 400 bars), and 5% EtOH exhibited the highest carotenoid yield, about 70% higher than the amount obtained using pure EtOH. By increasing the flow rate up to 30 g/min, no significant increase in the extraction yields was observed in all the equipment scales studied, while using larger equipment had a negative effect on the total carotenoid yield and total extract yield. Finally, the kinetics of the supercritical fluid extraction of carotenoids from *Ulva lactuca* was studied and the used hot ball diffusion model proved to be insufficient to predict the extraction process properly.