Supercritical CO_2 Extraction of Neutral Lipids from *Nannochloropsis maritima* & *Nannochloropsis salina:* Experiments and modelling

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The aim of this work was to determine the optimal operating conditions for an efficient extraction, in terms of yield and kinetics, of neutral lipids from *Nannochloropsis maritima* and *Nannochloropsis salina* using supercritical CO_2 (SC-CO_2) extraction at laboratory scale. The main applications targeted by this study are either nutraceuticals or biofuels. The effects of process parameters were studied on *Nannochloropsis maritima*: extraction experiments were performed at pressure range of 10 to 40 MPa and temperature range of 313 to 333 K, at a CO_2 flow rate of 0.5 kg/h. The effects of two drying modes were also studied: atomization and air flow drying. According to the results obtained on *Nannochloropsis maritima*, the effects of flow rate, water content and ethanol as co-solvent were investigated on *Nannochloropsis salina* at the best operating conditions corresponding to high extraction yields of lipids *i.e.* 30 and 40 MPa at 333 K. The extraction curves were fitted thanks to Sovova's mathematical model. The determination of concentrations of total carotenoids and chlorophyll a (Chl a) were carried out by measuring the absorbance of extracted samples diluted in pure acetone using a UV spectrophotometer. The extract analysis was performed by High Performance Thin Layer Chromatography (HP-TLC). The results obtained on *Nannochloropsis maritima* showed that the highest mass losses were obtained at a pressure of 40 MPa and a temperature of 333 K. Whatever the temperature, the mass losses and the extraction kinetics were found to be close at 20 and 30 MPa. The air flow drying gives higher mass losses and more rapid extraction kinetics than atomization drying. No polar lipids were extracted. The highest concentrations of Chl a and total carotenoids were obtained at a pressure of 30 MPa and a temperature of 323 K. The results obtained on *Nannochloropsis maritima* showed that increasing the flow rate leads to an extraction less limited by the diffusion, nevertheless the total amount extracted was not reached faster. Extraction experiments with samples containing water show that water acts as a barrier to diffusion of SC-CO_2 or lipids. Nevertheless, the presence of water leads to an increase in the concentration of Chl a in the extracts, but the concentration of total carotenoids was the lowest. Increasing the pressure from 30 to 40 MPa leads to an increase in the total carotenoids concentration in the SC-CO_2 extracts (about 29%). Nevertheless, no influence was observed on the concentration of Chl a. For both microalgae, Sovová's model was applied for modelling the extraction curves.