Kinetics of Supercritical Fluid Extraction of Lipids and Pigments from Microalgae

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In the last decade, attention has been focused on the extraction of lipids from algal biomass as a source of third generation biofuels. Supercritical fluid extraction (SFE) is one of the examined separation methods. The economic feasibility of extraction of lipids from dry algae with supercritical CO_2 and successive transesterification to biodiesel remains an open question; more promising seems to be a direct transesterification of wet algae with supercritical alcohol. On the other hand, food supplements containing lipids rich in polyunsaturated acids and carotenoids as strong antioxidants are successfully produced from microalgae by the extraction with supercritical CO_2. The kinetics of their SFE from microalgae has been studied and quantified using the first-order model [1], desorption model [2], and broken and intact cells (BIC) model [3]. The aim of this presentation was to collect the published kinetic data, synthesize them using the BIC model, and compare the model parameters for different microalgae.

The effect of microalgae pre-treatment, composition of solute and solvent, and extraction pressure and temperature on the mass transfer resistance and phase equilibrium is evaluated from experimental data on the kinetics of SFE of more than 10 microalgae strains including those frequently cultivated as *Spirulina* (*Arthrophira*) sp., *Chlorella* sp., *Schizochytrium limacinum* and *Haemathococcus pluvialis*. In most cases, the microalgae cell wall is of very low permeability and thus it must be disrupted before the extraction. Besides, polar pigments and lipids are not soluble in CO_2. To extract them, CO_2 should be modified with a smaller amount of polar solvent, usually ethanol. Finally, the modifier can enhance even the extraction of neutral lipids as the algae matrix is a good adsorbent for compounds to be extracted with CO_2 and keeps bound at least a part of the solute, unless it is released by the modifier.

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References

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