Kinetics of Supercritical Fluid Extraction of Carotenoids from Microalgae and Plants.

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Microalgae are regarded today as promising source of third generation of biofuels. However, a more appropriate utilization of microalgae which synthesize substances of high value in human nutrition as oil rich ω-3 and ω-6 unsaturated fatty acids and oil-soluble carotenoids is evident. Particularly suitable for the production of food supplements is the extraction with supercritical CO_2 because it preserves thermolabile bioactive substances and does not leave any traces of organic solvents in the product. The CO_2 extraction has been applied in industrial scale to obtain carotenoid astaxanthin from microalga *Haematococcus pluvialis*, cultivated to an extremely high content of carotenoids. To extract economically carotenoids from other microalgae, very high pressures have to be applied (> 50 MPa).

Many studies can be found in the literature on the CO_2 extraction of carotenoids from microalgae. Their mutual comparison offers opportunity to better understanding the process. We have shown that at least a part of oil extracted with CO_2 from microalgae is adsorbed on the matrix, and a consequence of increasing extraction pressure (and, above the cross-over pressure, also increasing the temperature) is not only an increase in oil solubility in supercritical CO_2 but also a release of the extract from the matrix [1]. Then, the mathematical model for the extraction of oil from microalgae was extended to include the extraction of carotenoids [2]. The model includes phase equilibrium and mass transfer resistance.
The solubility of carotenoids in CO_2 is related to the solubility of oil *via S*, the pressure- and temperature-dependent selectivity. Symbols in the figure represent experimental extraction yields from microalga [3] and lines the results of modelling. A comparison with a larger set of literature data confirms the increase of the carotenoids-to-oil selectivity with increasing pressure and temperature.

This contribution summarizes previous results of our analysis of data on the supercritical fluid extraction of carotenoids from microalgae, adds comparison of the mathematical model with newly available experimental data, and applies the model on CO_2 extraction of carotenoids from different plants, where equivalent extraction mechanisms are supposed to be valid.

References

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