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High Pressure Vapor - Liquid Phase Equilibrium Observations of System Vegetable Oil - Carbon Dioxide

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Phase equilibria data for systems rapeseed oil - CO₂ and corn germ oil - CO₂ were determined at temperatures 35°C, 45°C, 65°C and 85°C, and in pressure range from 100 bar to 550 bar. The oils were treated with saponification and hydrolysis procedure to separate fatty acids from triglycerides to obtain free fatty acid enriched oils and glycerol. The oils containing high concentration of free fatty acids are thermolabile and oxidative. The content of total free fatty acids in rapeseed and corn germ oil was 77 wt.% and 63 wt.%, respectively. Experiments using enriched oils were performed using high-pressure variable-volume view cell, where phase inversions were observed. At lower pressure the observed systems are composed of lower - oil-rich phase and upper - CO₂-rich phase. At certain pressure the phases were inverted, and lower - CO₂-rich and upper - oil-rich phase was obtained. The phase inversion for systems rapeseed oil - CO₂ and corn germ oil - CO₂ can be also observed in P-x-y diagrams. Samples from liquid and vapor phases were analyzed by gas chromatography for the content of free fatty acids. In comparison of two vegetable oils with different compositions of saponified oil, according to saturated (palmitic, stearic) and unsaturated (oleic, linoleic, linolenic) fatty acids, important conclusion was made, that each system vegetable oil - CO₂ is unique and that its phase behaviour depends on fatty acid composition.

Keywords

Phase equilibrium, supercritical carbon dioxide, vegetable oil, free fatty acid