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Separation of major and minor lipid components using supercritical CO_2 coupled with cross-flow reverse osmosis membrane filtration

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ABSTRACT

A reverse osmosis polyamide membrane was used to test the feasibility of concentrating triacylglycerol (TAG) and α-tocopherol/β-sitosterol from model mixtures (Oleic Acid (OA)/TAG and OA/α-tocopherol/β-sitosterol, respectively) solubilized in SC-CO_2 using cross-flow filtration regime. SG membrane was used for up to 26 h at pressures of 120 and 280 bar and temperature of 40°C and its performance was measured in terms of CO_2 flux and separation factor at a transmembrane pressure of 10 bar. Increasing the pressure to 280 bar resulted in a higher reduction in CO_2 flux in comparison to that at 120 bar, which was attributed to fouling. CO_2 flux was reestablished after cleaning with pure SC-CO_2. Feed pressure of 120 bar showed the best separation factors, where the OA separation factor was higher than 1 and those for TAG and α-tocopherol/β-sitosterol were less than 1. The preferential permeation of OA through the reverse osmosis membranes in comparison to TAG and α-tocopherol/β-sitosterol could be attributed to the higher diffusivity of this smaller molecular weight compound and the effect of plasticization and swelling of the membrane upon exposure to SC-CO_2. The cross-flow regime efficiently reduced the extent of fouling and subsequent decline of permeate flux. The findings demonstrate the potential to separate bioactive components present in vegetable oil deodorizer distillate and/or to deacidify vegetable oils using coupled supercritical and membrane technologies.

Key words: Cross-flow; lipids; reverse osmosis membrane; separation factor; supercritical CO_2