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Micro-flow process of emulsification and supercritical fluid extraction of emulsion for stearic acid lipid nanoparticle production

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Key Word (3 words)

Supercritical carbon dioxide, Solid lipid nanoparticle, Microfluidic system

Abstract (less than 300 words)

Solid lipid nanoparticles (SLN) represent as an active ingredients carrier that gives the attractive advantages such as controlled release and degradation protection of active compounds [1]. Supercritical fluid extraction of emulsion (SFEE) has been applied for fabrication of SLN. Utilization of supercritical carbon dioxide ($scCO_2$) can remove organic solvent at the mild processing temperature while conventional evaporation method at high temperature leading to the degradation of active compounds [2]. Furthermore, introduction of microfluidic system for SFEE allows the reduction of costs and time of the operation [3].

In this study, emulsification by micro-swirl mixer and SFEE in microchannel (inner diameter of 500 μm) are combined in micro-flow system for the formation of stearic acid lipid nanoparticles dispersed in aqueous solution. The effect of the surfactant species, surfactant concentrations and pressure on the size of stearic acid nanoparticles and extraction efficiency of ethyl acetate (EA) from the ethyl acetate in water (EA/W) emulsion are investigated. Tween 80 as hydrophilic surfactant was dissolved in water (0 to 3.0 wt%). Stearic acid (0.5 wt%) as lipid and egg yolk lecithin (0 to 1.5 wt%) as hydrophobic surfactant were dissolved in EA. The feeding flow rates of water and EA were 1.6 and 0.4 ml min^{-1}, respectively. The operating temperature was 40 ˚C. Ethyl acetate in water emulsion was formed by using micromixer. Supercritical carbon dioxide was applied for EA extraction from EA/W emulsion in microchannel. Increasing amount of lecithin results in higher uniformity of SLN size distribution. Variation of pressure has no significant effect on the extraction efficiency and all pressure conditions gave the high efficiency over 97%. However, higher pressure leads to larger average size and aggregated form of SLN. This phenomenon can be explained by the aggregation of SLN due to the loss of lecithin by the extraction into $scCO_2$ phase.

References

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