Synopsis of Original Research Paper

Development of quantitative evaluation methodology of cosmetic ingredients in emulsions by combined use of NMR and Cryo-TEM

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This study aimed to investigate the effect of different types of oil used in emulsions on the supersaturated dissolution behavior and liquid-liquid phase separation (LLPS) of active ingredients. Labrafil® M 1944 CS (M1944, hydrophilic-lipophilic balance (HLB): 9.0) and LabrafacTM PG (PG, HLB: 1.0) were used as oils with different hydrophobicity. Fenofibrate (FFB) was used as a model active ingredient that is poorly water-soluble. Cryo-TEM observations showed emulsion droplets less than 20 nm in diameter and FFB-rich droplets ranging from several tens nm to over 100 nm in diameter in each emulsion. 1H NMR analysis indicated that M1944 had minimal impact on the molecular environment of the FFB-rich phase. In contrast, the distribution of PG into the FFB-rich phase in the PG emulsion changed the molecular environment of the FFB-rich phase. This change reduced the chemical potential of the FFB-rich phase and, consequently, the FFB concentration dissolved in the bulk water. The present study clarified that LLPS of FFB occurs even in emulsions, forming the FFB-rich phase. The LLPS behavior of FFB varied depending on the type of oil used in the emulsion. Highly hydrophobic PG was liable to partition into the hydrophobic active ingredient-rich phase and reduce the concentration of the active ingredient dissolved in the bulk water. To improve the absorption of active ingredients in supersaturation-forming emulsion formulations, it is important to consider the effect of emulsion components on the LLPS of the active ingredient.