Gel Phase (Lβ) Formation by Mixed Saturated/Unsaturated Monoglycerides and the Influence of Triglyceride Oils - Thermodynamic Stability?

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It is well known that long chain monoglycerides form a metastable α-gel phase (Lβ) on cooling. Despite the inevitable storage problems, this state is frequently employed to stabilise emulsions or to incorporate “active” ingredients in many food and fragrance applications and for drug delivery. Simple thermodynamic considerations demonstrate that gel phases formed by mixed surfactants should be more stable than those formed by pure materials. We have examined the phase behaviour of mixed saturated/unsaturated monoglycerides (glycerol monostearate (GMS)/ glycerol monooleate (GMO)) to determine if gel phases will form with unsaturated monoglycerides and whether stable gel phases can be obtained with mixtures. We have also examined the behaviour in mixtures with liquid triglycerides. The lyotropic phases formed by GMO/GMS with vegetable oil are described. Optical microscopy was used to study the mesomorphic behaviour as function of temperature. We also employed differential scanning TA calorimetry (DSC) to determine the transition enthalpies between mesophases. Surfactant mobility in the various phases was also studied by measuring proton nuclear magnetic resonance (NMR) T2 relaxation times. In parallel we use small angle X-ray scattering (SAXS) to characterize the different mesomorphic phases at different temperatures. Various ordered phases have been recently reported for GMS/oil mixtures1,2 these being the “inverse lamellar” (α-gel) phase, the sub-α crystals and β-crystals, as well as the isotropic L2 phase. The “inverse lamellar” phase was assigned a structure with disordered hydrocarbon chains and ordered head groups. This sequence is different from the behaviour of the GMO/water system. Our results give insights into the detailed molecular mobility for the different phase structures. The results cast light into the phase behaviour of unsaturated monoglyceride in the non-aqueous system and demonstrate the potential for product formulations with stable α-gel phases.