Polymorphism and Crystallization Kinetics of *sn*-1,3-Distearoyl-2-oleoyl Glycerol (StOSt) by Hot Stage Microscopy in Combination with Image Analysis

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Sn-1,3-distearoyl-2-oleoyl glycerol (StOSt) is a disaturated-monounsaturated mixed fatty acid (Sat-O-Sat) triacylglycerol (TAG) and is abundant in many natural fats and oils, particularly confectionery fats. The chemical structure of StOSt results in relatively complex polymorphic behaviour under varying thermal conditioning, which influences the physical and chemical properties of fats. Knowledge of the crystallisation kinetics of these polymorphs is highly useful in the control of fat crystallization in the confectionery and wider food industries. In this study, isothermal crystallization events, both direct and melt-mediated transformation of the polymorphic forms of StOSt have been studied by Hot Stage Microscopy, and the growth and nucleation kinetics have been analysed using an image processing algorithm.

In the literature, six different polymorphs of StOSt have previously been reported: α, δ, γ, β', β_2 and β_1. In this work, for the first time the microstructures of all the polymorphs except β_1 have been observed under polarized light, using melting behaviour to distinguish polymorphs. The α-crystals displayed needle shape, γ-crystals a 'coarse mass' and β' and β_2 forms as spherulitic crystals. The rarely reported δ-form (melting temperature ~ 28°C) was observed to crystallize above 23°C, and was found to display a spherulitic crystal structure.

Induction times generally increased with increasing temperature. Induction times of δ and β' forms were found to be much shorter for melt-mediated crystallisation than for direct crystallization from liquid melt and showed rapid nucleation rates. Both nucleation rates and growth rates showed an optimum temperature. In case of the melt-mediated crystallization events the polymorphs exhibited comparatively slow growth rates.