Investigation of a Tripalmitin/Triolein System via Hot Stage Microscopy

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Knowledge of the fundamentals of nucleation rates, crystal growth, polymorphic transformations and eutectic behaviour of fat blends is important for controlling processing and storage conditions of foods. It is desirable to model these phenomena in order to predict the behaviour of fat blends and achieve certain structures and functionality. To begin to explore this, blends of tripalmitin (PPP)/triolein (OOO) (20, 40, 60, 80 or 100% PPP) were selected to represent a binary system with widely differing melting points such that PPP is the sole crystallising species and OOO acts as a solvent. This system was investigated using hot stage microscopy (HSM) and differential scanning calorimetry (DSC) over a range of isothermal temperatures. An advantage of HSM is that nucleation and crystal growth can be directly observed, whereas these cannot be deconvoluted from a DSC thermogram. Samples were held at 80°C for 5 minutes, supercooled to an isothermal te mperature during which time crystals grew and then finally re-melted at 1°C/min . Optical images were taken and analysed on MATLAB to produce growth rates, while melting points were determined both visually and by DSC. Rates of nucleation and crystallisation of PPP were higher and occurred sooner at lower (as compared with higher) isothermal hold temperatures. Two distinct polymorphs could be seen as crystals grew, one forming an outer ring (identified from subsequent melting behaviour as β′) and the other an inner circle (identified as β). An attempt was made to measure the growth rates of these polymorphs manually. The outer β′ polymorph grew at a faster rate than the inner β, which appear to grow via transformation of β′ via a buffer zone comprising melted material. At lower isothermal temperatures, β′ appeared to crystallise well before β, whereas, at higher isothermal temperatures, β appeared to nucleate just before β′ even though the β′ polymorph quickly formed the outer ring once nucleated. This latter observation is supported by growth rate data which show slow overall growth initially (corresponding to the growth rate of β) followed by much faster growth rates (corresponding to β′). Isothermal hold temperature had no significant impact on melting points.