Effect of Minor Components on the Crystallisation of Shea Stearin and Stearin Fractions Produced by Lipase-catalyzed Interesterification of High Oleic Sunflower Oil

Joydeep Ray[1], Kevin W. Smith[2], Krishnadath Bhaggan[3], Zoltan K. Nagy[1], Andrew G. F. Stapley*[1]

[1]Department of Chemical Engineering, Loughborough University, UK, LE11 3TU

[2]Fat Science Consulting Ltd, 16 Arundel Drive, Bedford, UK, MK41 8HP

[3]Loders Croklaan B.V., Hogeweg 1, 1521 AZ Wormerveer, The Netherlands

Shea stearin is one of the main commercial sources of hard fat, often used to prepare cocoa butter equivalents (CBE) by blending with palm mid fractions. In this study, nine different stearin fractions were obtained via solvent fractionation of interesterified fats produced by lipase-catalyzed interesterification of high oleic sunflower oil (HOSF) and various stearic-palmitic acid mixtures with about 30-35% yield.

The overall Sat-O-Sat TAGs (StOSt+POSt+POP) levels of the stearin fractions were approximately 90%, compared to 82% in the case of shea stearin. Significant amounts of oxidised compounds (0.1-2%) and DAGs (0.7-5.6%) in the stearin fractions, prompted silica treatment of the samples, reducing the oxidised compounds to 0-0.1% and DAGs to 0.1-0.9%. The effect of removing minor components on the crystallization of the samples was observed using three types of DSC techniques: (i) cooling crystallization (ii) isothermal crystallisation at 20°C, and (iii) the “stop and return” method following isothermal holds for different times at 20°C. Polymorphic confirmations were performed using XRD at 20°C, solid fat content (SFC) profiles were obtained by NMR and sample microstructures were observed over 1 week of storage at 20°C.

Comparing silica treated and non-silica treated samples showed that the presence of minor components resulted in a higher proportion of lower polymorphs and delayed the crystallization of higher forms. The transitions α → δ → γ of polymorphic forms (identified by melting peaks and XRD patterns) were also retarded by the presence of minor components. SFC profiles of the silica treated stearins were found to have higher solid contents at 35°C & 40°C, implying crystallization of higher polymorphic form (β_2) during the stabilization period, except a few samples which were low in StStSt TAGs. The silica treated stearins also produced more spherulitic crystal microstructures during 3 days of storage, most likely produced as a result of polymorphic transformation.