Production of structured triacylglycerols via enzymatic interesterification of medium-chain triacylglycerol and soybean oil using a pilot-scale solvent-free packed bed reactor

ABSTRACT

Oils rich in medium- and long-chain triacylglycerols (MLCT) serve as functional oils to help reduce body fat accumulation and weight gain. However, most of the MLCT-rich products on the market are physical blends of medium- and long-chain triacylglycerols (MCT and LCT, respectively) that are not structured triacylglycerols (TAG). In this study, an efficient pilot-scale packed bed reactor (PBR) of immobilized lipase from *Thermomyces lanuginosus* (Lipozyme® TL IM, Novozymes, Bagsvaerd, Denmark) was employed for producing structured MLCT *via* 1,3-specific interesterification of TAG enriched in caprylic and capric acyl groups and soybean oil (SBO). The PBR was operated under continuous recirculation mode in the absence of solvent. Optimal reaction conditions were determined to be: caprylic/capric TAG: SBO ratio (45:55 w/w), reaction temperature (75 °C) and residence time (16.0 min) on MLCT production were studied. When employing a pilot-scale PBR (100 kg day^{-1}) under optimal conditions, a product containing 76.61 wt% MLCT was produced. Lipozyme TL IM was reused for 25 successive batch reactions (125 kg substrates) with no significant reduction in catalytic efficiency. The light yellow MLCT-enriched product had a high level of saturated fatty acids (SFA, 82.74 wt%) in its *sn-2* position as a result of the enzyme's 1,3-positional specificity. One-stage molecular distillation and methanol extraction were used to remove the free fatty acids, mono-, and diacylglycerols generated from hydrolysis. With distillation temperature of 150 °C and oil-to-methanol ratio of 1:3 v/v, MLCT content was further increased to 80.07 wt%. The enzymatic PBR was therefore effective in producing structured MLCT at a pilot-scale under solvent-free conditions.