Production of medium-chain acylglycerols by lipase esterification in packed bed reactor: process optimization by response surface methodology

ABSTRACT

Medium-chain acylglycerols (or glycerides) are formed of mono-, di- and triacylglycerol classes. In this study, an alternative method to produce MCA from esterifying palm oil fatty acid distillate (PFAD) with the presence of oil palm mesocarp lipase (OPML) which is a plant-sourced lipase and PFAD is also cheap by-product is developed in a packed bed reactor. The production of medium-chain acylglycerols (MCA) by lipase-catalysed esterification of palm oil fatty acid distillate with glycerol are optimize in order to determine the factors that have significant effects on the reaction condition and high yield of MCA. Response surface methodology (RSM) was applied to optimize the reaction conditions. The reaction conditions, namely, the reaction time (30-240 min), enzyme load (0.5-1.5 kg), silica gel load (0.2-1.0 kg), and solvent amount (200-600 vol/wt). Reaction time, enzyme loading and solvent amount strongly effect MCA synthesis ($p<0.05$). However, water absorbent (silica gel) loading did not have significant ($p>0.05$) influence on MCA yield. Best-fitting models were successfully established for MCA yield ($R2 =0.9133$). The optimum MCA yield were 75% from the predicted value and 75.4% from the experimental data for 6 kg enzyme loading, a reaction time of 135min and a solvent amount of 350 vol/wt at 65°C reaction temperature. Verification of experimental results under optimized reaction conditions were conducted, and the results agreed well with the predicted range. Esterification products (mono-, di- and triacylglycerol) from the PBR were identified using Thin Layer Chromatography method. The chromatograms showed the successful fractionation of esterified products in this alternative method of process esterification.

Keyword: Esterification; Medium-chain acylglycerols (MCA); Oil palm mesocarp lipase; Packed bed reactor; Response surface methodology (RSM)