Production of a diacylglycerol-enriched palm olein using lipase-catalyzed partial hydrolysis: optimization using response surface methodology

ABSTRACT

Partial hydrolysis using Lipozyme RMIM lipase in a solvent-free system was used to produce a diacylglycerol (DAG)-enriched palm olein. Response surface methodology (RSM) was applied to model and optimize the reaction conditions namely water content (30– 70 wt% of enzyme mass), enzyme load (5–15 wt% of oil mass), reaction temperature (45–85 C) and reaction time (6–16 h). Well fitting models were successfully established for both DAG yield ($R^2 = 0.8788$) and unhydrolysed triacylglycerol (TAG) ($R^2 = 0.8653$) through multiple linear regressions with backward elimination. Chi-square test indicated that there were no significant ($P > 0.05$) differences between the observed and predicted values for both models. All reaction conditions had positive effects on DAG yield and negative effects on unhydrolysed TAG. Optimal reaction conditions were: 50 wt% water content, 10 wt% enzyme load, 65C of reaction temperature and 12 h of reaction time. The process was further up-scaled to a 9 kg production in a continuous packed bed bioreactor. Results indicated that upscaling was possible with a similar DAG yield (32 wt%) as in lab scale. Purification of the DAG oil using short path distillation yielded a DAG-enriched palm olein with 60 wt% DAG and 40 wt% TAG which is suitable for margarine, spread or shortening applications.

Keyword: Partial hydrolysis, Diacyglycerol, Rhizomucor meihei, Optimization, Response surface methodology, Palm olein, Central composite rotatable design (CCRD)