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Enzymatic Interesterification of Hard Stocks

*A project report presented in partial fulfillment of the requirements of the
Master of Food Technology at Massey University*

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Abstract

The objective of this study was to use enzyme interesterification to produce two hard stocks which were based on hard stocks used in the manufacture of margarine and pastry fats. Both of these two hard stocks produced need to be fast crystallizers; one with a low melting point for spreadable margarine while the other with a higher melting point for pastry fats. Commercial hard stocks were provided by Bakels Edible oil (BEO) Ltd. The study was divided into three stages. In the first stage, three commercial lipase enzymes supplied by Novozymes, including Novozyme 435, Lipozyme RM IM and Lipozyme TL IM, were used to interesterify tallow stearin, palm stearin and fully hardened coconut oil mixed in different ratios. The most promising fat blend with the lipase enzyme was selected for optimisation trials in stage two of the study. In stage two, the amount of lipase enzyme was investigated along with the time required to process these fats in order to optimise the interesterification method as both enzymes and production time are cost factors associated with the successful application of this hard stock. The commercial lipase enzymes are the key to the interesterification process and are expensive hence in stage three of this study, the reusability of the enzymes was looked into in order to determine the maximum number of uses that can take place for one dose of enzyme during batch processing. The resulting interesterified fats at the end of each stage were tested for physical properties such as melting point, solid fat content, rate of crystallization, and change in specific heat during crystallization and chemical composition of triglyceride content. The best result for spreadable margarine was a blend of palm stearin and fully hardened coconut oil at 50%:50% and interesterified with 4% of Lipozyme TL IM at 65°C for 8 hours to achieve a melting point of 44°C. The best processing method for pastry margarine was blend of tallow stearin and fully hardened coconut oil at 70%:30% interesterified with 4% of Lipozyme RM IM at 65°C for 8 hours to achieve a melting point of 44°C. Both of these interesterified hardstocks were also fast crystallisers as determined using differential scanning calorimetry and nuclear magnetic resonance instrumentation. Each batch of enzyme was able to be reused up to seven times if washed with acetone and deionized water.

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List of Abbreviations

| Abbreviation | Full name |
|--------------|-----------------------------------------------|
| SFC | Solid fat content |
| DSC | Differential scanning calorimetry |
| HPLC | High pressure liquid chromatography |
| TAG | Triglyceride |
| ECN | Equivalent carbon number |
| TS | Tallow stearin |
| PS | Palm stearin |
| FHCO | Fully hardened coconut oil |
| TSFHCO | Tallow stearin and fully hardened coconut oil |
| PSFHCO | Palm stearin and fully hardened coconut oil |
| TSPS | Tallow stearin and palm stearin |
| Cp | Caprylic acid |
| C | Capric acid |
| L | Lauric acid |
| M | Myseric acid |
| P | Palmitic acid |
| O | Oleic acid |
| S | Stearic acid |

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- Table 23 *TAG composition for 2% to 8% RM enzyme interesterified tallow stearin and fully hardened coconut oil at 70% to 30%*
- Table 24 *TAG composition for 2% and 8% TL enzyme interesterified palm stearin and fully hardened coconut oil (PS:FHCO 50:50).*
- Table 25 *The time taken for hard stocks to reach constant SFC values during crystallization from 60°C and cooling at 0°C*
- Table 26 *TAG content of RM7.3 TS: FHCO (70:30) with 4% enzyme interesterified at 65 ± 1°C then washed with ethanol.*

- Table 27 TAG content of RM7.3 TS: FHCO (70:30) with 4% enzyme interesterified at $65 \pm 1^\circ\text{C}$ then washed with chloroform.*
- Table 28 TAG content of RM7.3 TS: FHCO (70:30) with 4% enzyme interesterified at $65 \pm 1^\circ\text{C}$ then washed with isooctane.*
- Table 29 TAG content of RM7.3 TS: FHCO (70:30) with 4% enzyme interesterified at $65 \pm 1^\circ\text{C}$ then washed with acetone.*