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INTERESTERIFICATION WITH IMMOBILIZED ENZYMES

PH Berben[1], C Groen[1], MW Christensen[2] and HC Holm[2]
[1] Engelhard Corporation, P.O. Box 19, 3454 ZG De Meern, The Netherlands
[2] Novo Nordisk A/S, Novo Allé, 2880 Bagsvaerd, Denmark

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Introduction

Interesterification is one of the processes to modify the properties of triglyceride mixtures. In this reaction the fatty acid chains are redistributed over the triglyceride molecules. As a result the melting characteristics of the product have changed compared to the starting mixture. Industrially, sodium methylate is applied for random interesterification.

The use of sodium methylate on industrial scale has disadvantages. It is a strong basic chemical that needs careful handling. It also reacts vigorously with water. Therefore, the raw oils need to be dried before use. Finally, the sodium ions have to be removed from the product by post treatment steps. The additional steps add cost to the overall process.

Enzymes also catalyze the interesterification reaction. Traditionally, enzymes have been used for the production of higher value add products, such as cocoa butter extenders. A new immobilized lipase enzyme, Lipozyme TL, has been developed for bulk interesterification processes to produce margarines, spreads and frying oils. This enzyme delivers benefits equivalent to the current leading chemical treatment – sodium methylate – while eliminating problems and costs associated with feedstock pretreatment and product post treatment, shelf life, moisture sensitivity, and yield loss due to soap formation. Lipozyme TL addresses low trans issues cost effectively and does not expose fats and oils to chemicals. Compared to earlier enzymes, no water is needed to sustain the activity of the lipase.

Immobilization

Novozymes developed a new technology to immobilize lipases. The support is a well defined silica. The liquid lipase *Thermomyces Lanuginosus* is atomized onto dry silica and agglomerated in plough share mixtures. Binders are added to ensure sufficient

mechanical strength. Finally, the lipase on silica is dried into a fine powder with a defined particle size distribution.
The resulting powder has a particle size of 300 to 1000 microns. The BET surface area is 50 m^2 per g. The particles are robust. In a mechanically stirred reactor in which reaction conditions were simulated no change in the average particle size was observed.

Performance

The performance of the immobilized lipase was measured in a stirred vessel at ambient pressure. The catalyst loading was between 2 and 14 wt.%. The reactor temperature was 60–90 °C. The vessel was nitrogen blanketed. It is important to note that no additional water had to be added (also not in re-use experiments) to maintain the enzyme activity. The feedstocks used were a mixture of soybean oil and hardened soybean oil (75 : 25) and a mixture of palm stearine and coconut oil (60 : 40).

The reaction does not occur instantaneously. Equilibrium is reached in a few hours, depending on the reaction conditions. The activity is a function of the particle size in that smaller particles result in higher activities. Also the enzyme specificity was measured by analyzing the fatty acid distribution at the Sn-2 position. In comparison to the starting feedstock blend, enzymatic interesterification with Lipozyme TL retains approximately 82% of a certain fatty acid at the Sn-2 position, while chemical interesterification with sodium methylate results in 48% retention. Hence, the enzyme is 1,3 specific.

In ten subsequent re-use runs no deactivation of the lipase was observed. The free fatty acid content and the amount of di-acylglycerides became stable after the second run. In the first two runs the FFA and DAG values are somewhat higher, most probably caused by the release of excess water from the silica surface.

The products made by enzymatic interesterification have the same Solid Fat Content curves as the products made by chemical interesterification.

The particle size of Lipozyme TL is such that the product can be applied both in a batch and a fixed bed reactor. Preliminary results obtained in a fixed bed column reactor show that the system quickly reaches a stable performance level. In 50 hours on stream no deactivation was observed.

Conclusion

Lipozyme TL IM is a cost effective, robust, 1,3-specific, immobilized lipase. It is active in interesterification, both in batch- and fixed-bed reactors. The SFC curves of products made by interesterification with sodium methylate and Lipozyme TL IM are comparable. No addition of water is needed in re-use experiments to maintain the activity of the lipase.