

## Enzymatic Synthesis of Surfactant-like Compounds

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### Introduction

Fatty esteramines, or esterquats, are biodegradable raw materials for cationic surfactants (Puchta *et al.*, 1991) and are commonly incorporated into household and toiletry products as well as corrosion inhibitors. They can be synthesized from fatty acids and alkanolamines via a rapid but energy intensive chemical process (Antonio *et al.*, 1991), or, a milder, hence energy-saving, enzyme-based pathway (Idris *et al.*, 1995). The latter approach, being more selective, also results in less by-products, so reducing the off-colours and odours, which frequently require extensive downstream refining procedures. Therefore, the aim of this project was to develop and optimize such a process with lipase as the biocatalyst for the substrate pair comprising oleic acid and triethanolamine.

### Materials and Methods

Reactions were set up with equimolar amounts of the substrates oleic acid and triethanolamine in hexane (2 ml). 40 mg of enzymes were added and the reactions then allowed to proceed under various predetermined conditions. After a certain period, the reactions were terminated with the addition of acetone:ethanol (1:1) and the mono-, di- and tri-esteramines making up the product mixture were separated via column chromatography. The products were then detected and analysed with thin layer (chloroform:methanol, 90:10, v/v) as well as gas chromatography.

To determine the percentage of conversion of the substrate oleic acid, autotitration with 0.05M NaOH to the endpoint of pH 12 was also carried out.

### Results and Discussion

Screening of a range of native and immobilized enzymes revealed the immobilized lipase preparation Lipozyme IM60 to be the best biocatalyst with the reaction running optimally at 50°C at a shaking speed of 350 rpm. The optimal substrate ratio was found to be 3:1 (oleic acid: triethanolamine) while the maximum substrate conversion was achieved after 10 h. Under these optimal conditions, a 75% conversion of the substrate oleic acid was obtained which surpassed that of 50-60% previously reported (Idris *et al.*, 1995). Finally, the optimized reaction was successfully graduated 20 times to laboratory scale with a working volume of 50 ml. The model batch reactor consisted of a round bottom flask immersed in a thermostated water bath and equipped with an overhead stirrer.

### Conclusions

The surfactant compounds oleic esteramines were successfully obtained via lipase biocatalysis. Under optimal conditions, 75% of substrate conversion was achieved with the products easily separated and identified using column, thin layer and gas chromatography.

### Benefits from the study

None reported.

### Literature cited in the text

- Antonio, T., Joaquim, B. and Jessus, P. 1991. PCT Int. Appl. WO 9101,295.
- Idris, Z., Basri, M., Ahmad, S., Wan Yunus, W.M.Z., Ampon, K., Razak, C.N.A. and Salleh, A.B. 1995. Lipase Catalysed Synthesis of Fatty Esteramines, *Proceeding: The 6<sup>th</sup> Asian Chemical Congress, Manila, The Phillipines*, 22-24<sup>th</sup> May, 1995.
- Puchta, R., Krings, P. and Sandkuhler, P. 1991. Cesio World Conference on Detergents.

### Project Publications in Refereed Journals

None.

### Project Publications in Conference Proceedings

- Idris, Z., Basri, M., Ahmad, S., Wan Yunus, W.M.Z., Ampon, K., Razak, C.A.N. and Salleh, A.B. 1995. Lipase Catalysed Synthesis of Fatty Esteramines, *Proceeding: The 6<sup>th</sup> Asian Chemical Congress, Manila, The Phillipines*, 22-24<sup>th</sup> May, 1995.
- Salleh, A.B., Balakrishnan, P., Yusof, W.Y.W., Basri, M. and Razak, C.A.N. 1997. Production of Oleochemical Surfactants, *Seminar Penyelidikan Fakulti, FSAS, UPM*, 17 Dec 1997.

### Graduate Research

- Zainab Idris. 1996. Enzymology [M Sc]. Universiti Putra Malaysia.