

PROTECTIVE EFFECTS OF DAILY CLOTHING AGAINST  
SOLAR ULTRAVIOLET RADIATION. *Pseudomonas*  
CLOTHES LINE

ANALYSIS OF THE ANTOXIDANT PROPERTIES

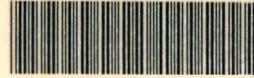
OF CLOTHING AND CLOTHING MATERIALS  
AND ANTOXIDANT CAPACITIES OF CLOTHING MATERIALS  
2005

a/2048

Peroustakaan  
Kolej Universiti Sains Dan Teknologi Malaysia (KUSTEM)

1100036809

LP 16 FST 1 2005



1100036809

## Transesterification of palm olein in organic solvents by an immobilized *pseudomonas cepacia* lipase / Liviani@Nur Atiqah Lausin.



PERPUSTAKAAN

**KOLEJ UNIVERSITI SAINS & TEKNOLOGI MALAYSIA  
21030 KUALA TERENGGANU**

1100036809

Lihat sebelah

HAK MILIK  
PERPUSTAKAAN KUSTEM

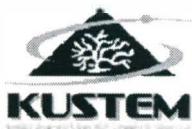
TRANSESTERIFICATION OF PALM OLEIN IN ORGANIC SOLVENTS BY AN  
IMMOBILIZED *Pseudomonas cepacia* LIPASE

By

Liviani @ Nur Atiqah binti Lausin

Research Report submitted in partial fulfillment of  
the requirements for the degree of  
Bachelor of Science (Biological Sciences)

Department of Biological Sciences  
Faculty of Science and Technology  
KOLEJ UNIVERSITI SAINS DAN TEKNOLOGI MALAYSIA  
2005



JABATAN SAINS BIOLOGI  
FAKULTI SAINS DAN TEKNOLOGI  
KOLEJ UNIVERSITI SAINS DAN TEKNOLOGI MALAYSIA

PENGAKUAN DAN PENGESAHAN LAPORAN  
PROJEK PENYELIDIKAN I DAN II

Adalah ini diakui dan disahkan bahawa laporan penyelidikan bertajuk: Transesterification of Palm Olein in Organic Solvents by an Immobilized Amano Lipase PS-C1 oleh Liviani @ Nur Atiqah binti Lausin, no. matrik: UK 7489 telah diperiksa dan semua pembetulan yang disarankan telah dilakukan. Laporan ini dikemukakan kepada Jabatan Sains Biologi sebagai memenuhi sebahagian daripada keperluan memperolehi Ijazah Sarjana Muda Sains (Sains Biologi) Fakulti Sains dan Teknologi, Kolej Universiti Sains dan Teknologi Malaysia.

Disahkan oleh:

Penyelia Utama **HAZLINA AHAMAD ZAKERI**

Nama:  
Pensyarah  
Jabatan Sains Biologi  
Fakulti Sains dan Teknologi  
Kolej Universiti Sains dan Teknologi Malaysia (KUSTEM)  
Negeri Tanggang Telipot  
21030 Kuala Terengganu, Terengganu Darul Iman.

Tarikh: **14/4/2005**

Penyelia Kedua (jika ada)

Nama:

Cop Rasmi

Tarikh: .....

Ketua Jabatan Sains Biologi

Nama:

Cop Rasmi: **PROF. MADYA DR. NAKISAH BT. MAT AMIN**  
*Ketua*  
Jabatan Sains Biologi  
Fakulti Sains dan Teknologi  
Kolej Universiti Sains dan Teknologi Malaysia  
(KUSTEM)  
21030 Kuala Terengganu.

Tarikh: **14/4/05**

**1100036809**

## **ACKNOWLEDGEMENTS**

First of all, I would like to express my sincere appreciation to my supervisor, Cik Hazlina Ahamad Zakeri for her guidance, advice, encouragement and understanding. Without her cooperation, patience and full support, this thesis will not survive.

My warmest gratefulness also goes to my family. Without their encouragement, criticism, understanding and support, I would not finish this thesis on time.

A special appreciation to my friends, especially Siti Nur Alia, Siti Khatijah Aminah and Nurasiah, who always willing to give their full support during the process of completing this study. Thanks for your encouragement, caring, understanding and patience.

I also would like to take this opportunity to thank the science officers, Cik Ku Naiza Ku Nordin and Cik Norazlina Abdul Aziz for their constant help in using HPLC. Thanks for their kindness, guidance, patient and their valuable time in helping me to complete my laboratory work.

Last but not least, thanks for the entire lab assistants for their help and cooperation given during the laboratory work.

## TABLE OF CONTENTS

	Page
<b>ACKNOWLEDGEMENTS</b>	ii
<b>LIST OF TABLES</b>	v
<b>LIST OF FIGURES</b>	vi
<b>LIST OF ABBREVIATIONS</b>	vii
<b>LIST OF APPENDICES</b>	viii
<b>ABSTRACT</b>	ix
i	
<b>ABSTRAK</b>	x
<b>CHAPTER 1</b>	<b>INTRODUCTION</b>
	1
<b>CHAPTER 2</b>	<b>LITERATURE REVIEW</b>
2.1	Palm olein
2.1.1	4
2.1.2	Food uses of palm olein
2.1	6
2.2	Lipases
2.2.1	8
2.2.2	Industrial application of lipases
2.2.3	9
2.2.2	Lipase in organic solvents
2.2.3	11
2.2.3	Immobilization of enzyme
2.2.3	15
<b>CHAPTER 3</b>	<b>METHODOLOGY</b>
3.1	Materials
3.2	Methods
3.2.1	Transesterification reaction
3.2.2	17
3.2.2	Effect of different organic solvents as reaction media
3.2.3	18
3.2.3	Removal of free fatty acids from transesterified oils
3.2.4	18
3.2.4	HPLC analysis
3.2.4	20
<b>CHAPTER 4</b>	<b>RESULTS</b>
	21
<b>CHAPTER 5</b>	<b>DISCUSSION</b>
	34
<b>CHAPTER 6</b>	<b>CONCLUSION AND RECOMMENDATION</b>
	36

<b>REFERENCES</b>	37
<b>APPENDICES</b>	45
<b>CURRICULUM VITAE</b>	52

## LIST OF TABLES

<b>Table</b>	
	<b>Page</b>
2.1 Typical triglyceride composition of palm oil and palm olein	5
2.2 Characteristic of refined, bleached and deodorized (RBD) palm olein	6
4.1 Percentage concentration of peaks observed on HPLC profile of non-transesterified and palm olein transesterified in various organic solvents.	32
A.1 Calculations of the percentage of free fatty acids removed	44
B.1 Example of calculating the degree of transesterification	45

## LIST OF FIGURES

<b>Figure</b>	<b>Page</b>
4.1 HPLC profile of non-transesterified palm olein (a) and palm olein transesterified in dimethylsulphoxide (b).	22
4.2 HPLC profile of non-transesterified palm olein (a) and palm olein transesterified in tetrahydrofuran (b)	24
4.3 HPLC profile of non-transesterified palm olein (a) and palm olein transesterified in diethylether (b)	26
4.4 HPLC profile of non-transesterified palm olein (a) and palm olein transesterified in heptane (b)	28
4.5 HPLC profile of non-transesterified palm olein (a) and palm olein transesterified in isoctane (b)	30
C.1 Palm olein	46
C.2 Glyceride sample in sample tube	47
D.1 Orbital shaker	48
D.2 FFA removal process	49
D.3 Reverse-Phase High Performance Liquid Chromatography	50

## LIST OF ABBREVIATIONS

$a_w$	water activity
HLPC	High performance liquid chromatography
DoH	Degree of hydrolysis
DoT	Degree of transesterification
DMSO	Dimethylsulphoxide
DET	Diethylether
THF	Tetrahydrofuran
RBD	Refined, bleached and deodorized
CF	Cystic fibrosis
PCL	<i>Pseudomonas cepacia</i> lipase
NaOH	Sodium hydroxide
KOH	Potassium hydroxide
DAD	Diode array detector
FFA	Free fatty acid
NT	Non-transesterified
T	Transesterified

## **LIST OF APPENDICES**

<b>Appendix</b>		<b>Page</b>
A	Removal of FFA from transesterified palm olein	45
B	Example of calculating the degree of transesterification ( $D_oT$ )	46
C	Sample analysis	
D	Equipment used	48

## ABSTRACT

The effect of organic solvents as reaction medium for transesterification of palm olein was studied. The organic solvents used were: dimethylsulphoxide ( $\log P -1.30$ ), tetrahydrofuran ( $\log P 0.49$ ), diethylether ( $\log P 0.85$ ), heptane ( $\log P 4.0$ ) and isoctane ( $\log P 4.52$ ). Transesterification reaction was carried out at  $60^{\circ}\text{C}$  and 200 rpm for 6 hours using an immobilized lipase from *Pseudomonas cepacia* as catalyst. The catalytic performance of the lipase was appraised by determining the changes in peak composition and concentrations by Reverse-Phase High Performance Liquid Chromatogram (RP-HPLC) and the calculated degree of hydrolysis (DoH) as well as degree of transesterification (DoT). Transesterification resulted in an increase in Peak 6 and 7 for all the solvents studied except for diethylether. Peak 1 and 3 show increase in at least three of the solvents (i.e. tetrahydrofuran, heptane and isoctane). Peak 5 also observed to increase in three solvents (i.e. dimethylsulphoxide, tetrahydrofuran and heptane). Peak 9 shows increase in two solvents (i.e. dimethylsulphoxide and heptane) whilst Peak 2 increases only in diethylether. Peak 4 and 8 were observed only in diethylether. D<sub>0</sub>H was highest when tetrahydrofuran was used with 5.01%. This is followed by dimethylsulphoxide with 3.95%, diethylether with 3.95%, heptane with 2.84% and isoctane with 2.73%. Heptane gave the highest value of D<sub>0</sub>T with 4.37%, followed by diethylether with 2.37%, isoctane with 2.08%, tetrahydrofuran with 2.04% and dimethylsulphoxide with 0.61%. The most suitable condition for transesterification using *P. cepacia* lipase was in heptane.

# **TRANSESTERIFIKASI MINYAK OLEIN KELAPA SAWIT DI DALAM PELARUT ORGANIK OLEH ENZIM *Pseudomonas cepacia* LIPASE TERSEKAT-GERAK**

## **ABSTRAK**

Kesan pelarut organik sebagai medium tindakbalas untuk transesterifikasi minyak olein kelapa sawit telah dikaji. Pelarut organik yang digunakan ialah dimetilsulfoksida ( $\log P = 1.30$ ), tetrahidrofuran ( $\log P = 0.49$ ), dietileter ( $\log P = 0.85$ ), heptana ( $\log P = 4.0$ ) dan isooktana ( $\log P = 4.52$ ). Tindakbalas transesterifikasi telah dilakukan pada suhu  $60^{\circ}\text{C}$  dan pada kelajuan 200 rpm selama 6 jam menggunakan enzim *Pseudomonas cepacia*. Tindakbalas pemangkinan ditentukan melalui perubahan komposisi dan luas puncak oleh RP-HPLC dan pengiraan darjah hidrolisis (DoH) dan darjah transesterifikasi (DoT). Transesterifikasi menghasilkan peningkatan pada luas puncak 6 dan 7 pada semua pelarut kecuali dalam dietileter. Puncak 1 dan 3 menunjukkan peningkatan dalam tiga pelarut (tetrahidrofuran, heptana dan isooktana). Puncak 5 juga menunjukkan peningkatan dalam tiga pelarut (dimetilsulfoksida, tetrahidrofuran dan heptana). Puncak 9 menunjukkan peningkatan dalam dua pelarut (dimetilsulfoksida dan heptana) sementara Puncak 2 hanya meningkat di dalam dietileter. Puncak 4 dan 8 hanya muncul di dalam dietileter. DoH memberikan nilai paling tinggi apabila tetrahidrofuran digunakan dengan 5.01%. Ini diikuti oleh dimetilsulfoksida dengan 3.95%, dietileter dengan 3.95%, heptana dengan 2.84% dan isooktana dengan 2.73%. Heptana memberikan nilai DoT paling tinggi iaitu 4.37 % diikuti oleh dietileter dengan 2.37%, isooktana dengan 2.08%, tetrahidrofuran dengan 2.04% dan dimetilsulfoksida dengan 0.61%. Keadaan yang paling sesuai untuk transesterifikasi menggunakan *P. cepacia* lipase adalah di dalam heptana.