

THE UNIVERSITY OF CHICAGO  
DEPARTMENT OF CHEMISTRY  
5700 SOUTH CAMPUS DRIVE  
CHICAGO, ILLINOIS 60637

RECEIVED

LIBRARY OF THE UNIVERSITY OF CHICAGO

100 EAST HARTWELL DRIVE, CHICAGO, ILLINOIS 60607

1100030768

PERPUSTAKAAN KOLEJ UNIVERSITI SAINS & TEKNOLOGI MALAYSIA (KUSTEM)			
Pengarang Ooi Beng Wooi		No. Panggilan HP 15 FST 16 2004	
Judul of Fatty acid Composites			
Tarikh	Waktu Pemulangan	Nombor Ahli	Tanda tangan



**FATTY ACID COMPOSITION OF TRANSESTERIFIED COD LIVER OIL  
AND SUNFLOWER OIL USING IMMOBILIZED *Rhizomucor miehei* LIPASE  
IN ORGANIC SOLVENTS**

**By**

**Ooi Keng Wooi**

**Research Report submitted in partial fulfilment 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  
2004**

## **ACKNOWLEDGEMENT**

To my family who always by my side whenever I need them for their support and love, I would like to thank them dearly here even though I know I can never thank them enough.

My second deepest gratitude goes to Cik Hazlina Ahamad Zakeri for her support, guidance and valuable advice not only as a supervisor to my final year project but also as a mentor. Without her guidance, I would not be able to learn so much in the progress of completing this final year project. To Cik Ku Naiza and Cik Norazlina, my sincere appreciation and thank you for your guidance and advice in doing my laboratory work.

Last but not least, I would like to thank all my friends and course mates, thank you very much for those helping hands whenever I needed it. I really appreciate it. A special thank you once again to all of the above named and those who are not mentioned for helping me in making this final project a success.

## CONTENTS

	PAGE
ACKNOWLEDGEMENT	ii.
CONTENTS	iii.
LIST OF TABLES	vi.
LIST OF FIGURES	vii
LIST OF SYMBOLS	viii
LIST OF APPENDICES	ix
ABSTRACT	x
ABSTRAK	xi
1.0 INTRODUCTION	1
2.0 LITERATURE REVIEW	4
2.1 Fats and Oils	4
2.1.1 The Components of Fats and Oils	4
2.1.2 Sources of Fats and Oils	4
2.1.2.1 Sunflower Oil	6
2.1.2.2 Fish Oil	9
2.2 Fatty Acids	10
2.2.1 Classification and Composition of Fatty Acids	10



2.2.2 Essential Fatty Acids (Omega-3 Fatty Acids)	14
2.2.3 Health Benefits of Essential Fatty Acids	16
2.2.4 Analysis of Fatty Acids	18
2.2.4.1 Gas chromatography	18
2.2.4.2 Liquid chromatography	19
2.3 Interesterification	21
2.3.1 Definition and Classification of Interesterification	21
2.3.2 The Use of Lipase in Interesterification	22
3.0 MATERIALS AND METHODS	25
3.1 Materials	25
3.2 Methodology	25
3.2.1 Interesterification reaction	25
3.2.2 Effect of Various Organic Solvents on Interesterification Reaction	26
3.2.3 Hydrolytic Activity and Removal of FFA	26
3.2.4 Fatty Acids Analysis Using Gas Chromatography (GC)	27
4.0 RESULTS AND DISCUSSION	28
4.1 Determination of Fatty Acid Composition in Cod Liver Oil and Sunflower Oil Before and After Transesterification	28
4.1.1 Fatty Acid Composition in Original Cod Liver Oil and Original Sunflower Oil	28
4.1.2 Fatty Acid Composition of Non-transesterified and Transesterified Blend	32
4.2 Effect of Various Organic Solvents in Transesterification with Cod Liver Oil and Sunflower Oil.	37

4.3 Effect of Transesterification on Different Blends of Cod Liver Oil and Sunflower Oil	42
5.0 CONCLUSION AND RECOMMENDATION	51
REFERENCES	53
APPENDICES	59



## LIST OF TABLES

<b>TABLE</b>	<b>PAGE</b>
1. World production of fats and oils by commodity	7
2. GLC fatty acid ranges in codex standards for sunflower oil	8
3. Characterization of important fatty acids in foods	13
4. Fatty acids composition of original cod liver oil and original sunflower oil	30
5. Fatty acids composition of non-transesterified and transesterified cod liver oil : sunflower oil (1:1) blend	36
6. Fatty acids composition before and after transesterification in different organic solvents.	43
7. Fatty acids composition before and after transesterification in different blends of cod liver oil and sunflower oil	50

## LIST OF FIGURES

FIGURE	PAGE
1. Precursor of arachidonic acid, and omega-3 fatty acid, the precursor of eicosapentanoic acid	11
2. The metabolism of three different families of polyunsaturated fatty acids	15
3. Fatty acids composition of original cod liver oil	29
4. Fatty acids composition of original sunflower oil	30
5. Fatty acids composition of non-transesterified blend	33
6. Fatty acids composition of transesterified blend	34
7. Fatty acids composition of transesterified blend in diethyl ether	38
8. Fatty acids composition of transesterified blend in hexane	39
9. Fatty acids composition of transesterified blend in isooctane	40
10. Fatty acids composition of non-transesterified I with cod liver oil:sunflower oil (2:3) blend	44
11. Fatty acids composition of transesterified oil with cod liver oil:sunflower oil (2:3) blend	45
12. Fatty acids composition of non-transesterified oil with cod liver oil:sunflower oil (3:2) blend	46
13. Fatty acids composition of transesterified oil with cod liver oil:sunflower oil (3:2) blend	47

## LIST OF SYMBOLS

$\alpha$	-	Alpha
cm	-	Centimeter
DHA	-	Docosahexaenoic acid
EPA	-	Eicosapentaenoic acid
FFA	-	Free fatty acid
GC	-	Gas chromatography
g	-	Gram
kg	-	Kilogram
m	-	Meter
$\mu\text{L}$	-	Microliter
$\mu\text{m}$	-	Micrometer
mL	-	Milliliter
mm	-	Millimeter

## LIST OF APPENDICES

### APPENDIX

1. Cod liver oil and sunflower oil
2. Orbital shaker
3. Oven
4. Weighing apparatus and agitators
5. Gas chromatography machine

Calculation of free fatty acids removed

Chromatogram (standard) of fatty acid.

## ABSTRACT

Fats and oils are important sources of food for human. Other than that, fats and oils are also important in industrial application. Fats and oils are composed of lipid, which contain monoglycerides, diglycerides and triglycerides; and free fatty acids. Nowadays, human care a lot about the nutritional value of fats and oils that they take everyday. Cod liver oil and sunflower oil had been transesterified by using immobilized *R.miehei* lipase. The transesterification was done in different organic solvents (diethyl ether, hexane and isooctane) to verify the enzyme's activity in different log *P* values. The transesterification had also been carried out in different blending of cod liver oil and sunflower oil. The results showed that changes had been occurred after transesterification. The composition of fatty acids in transesterified oil with the non-transesterified oil is different. The enzyme's activity was greatest in hexane. The 3:2 ratio of cod liver oil and sunflower oil was found to be the most suitable ratio for transesterification of cod liver oil with sunflower oil due to an increase in polyunsaturated fatty acids composition.

## ABSTRAK

Lemak dan minyak merupakan sumber penting dalam pemakanan manusia. Selain itu, lemak dan minyak juga penting dalam aplikasi industri. Kandungan lemak dan minyak adalah terdiri daripada monogliserida, digliserida dan trigliserida serta asid lemak bebas. Kini, manusia amat mengambil berat tentang nilai nutrisi lemak dan minyak yang diambil setiap hari. Minyak ikan kod dan minyak bunga matahari telah ditransesterifikasi dengan menggunakan *R. miehei* lipase tersekat-gerak. Transesterifikasi ini telah dijalankan dalam pelarut organik yang berbeza (dietil eter, heksana dan isooktana) untuk membuktikan aktiviti enzim dalam nilai log  $P$  yang berbeza. Transesterifikasi juga dijalankan dengan menggunakan nisbah yang berbeza antara minyak ikan kod dan minyak bunga matahari. Keputusan telah menunjukkan perubahan berlaku selepas transesterifikasi. Kandungan asid lemak dalam minyak yang ditransesterifikasi adalah tidak sama dengan minyak yang tidak ditransesterifikasi. Aktiviti enzim adalah paling aktif dalam pelarut organik heksana. Transesterifikasi adalah paling sesuai dengan nisbah 3:2 antara minyak ikan kod dengan minyak bunga matahari kerana peratus kandungan asid lemak politak-tepu yang digabungkan meningkat.