

FACTORS AFFECTING COMPOSITION OF ENRICHMENT  
AND DEPLETION OF URANIUM OXIDE CONCENTRATIONS  
IN URANIUM DIOXIDE FUEL ELEMENTS

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**FATTY ACIDS COMPOSITION OF ENZYMATICALLY  
TRANSESTERIFIED COD LIVER OIL/SOYBEAN OIL BLENDS BY  
IMMOBILIZED *Rhizomucor miehei* LIPASE**

**By**

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

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DEPARTMENT OF BIOLOGICAL SCIENCES  
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APPROVAL AND CERTIFICATION FORM  
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## LIST OF ABBREVIATIONS

ALA	= $\alpha$ -Linolenic acid
ARA/AA	= Arachidonic acid
C16:0	= Palmitic acid
C18:0	= Stearic acid
C18:1	= Oleic acid
C18:2	= Linoleic acid
C18:3	= Linolenic acid
C20:5n3	= EPA
C20:6n3	= DHA
CLO	= Cod liver oil
DHA	= Docosahexaenoic acid
EPA	= Eicosapentaenoic acid
FAME	= Fatty acid methyl ester
FFA	= Free fatty acid
GC	= Gas chromatography
GC-FID	= Gas chromatography- flame ionization detector
LA	= Linoleic acid
LC-PUFA	= Long-chain polyunsaturated fatty acid
n-3 PUFA	= Omega-3 polyunsaturated fatty acid
n-6 PUFA	= Omega-6 polyunsaturated fatty acid
PUFA	= Polyunsaturated fatty acid
SBO	= Soybean oil
ST	= Structure triglyceride

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## ABSTRACT

In an effort to improve the functionality and nutritional qualities of soybean oil, the enzymatic transesterification of cod liver oil-soybean oil (CLO-SBO) blends with different ratios (1:1, 2:3 and 3:2) in water-saturated hexane was investigated. The enzyme used was 1, 3-specific lipase from *Rhizomucor miehei*. Results indicated that SBO was rich with linoleic acid while CLO was abundant with omega-3 polyunsaturated fatty acids (n-3 PUFAs). Transesterification between cod liver oil and soybean oil did occur. Transesterification did not much alter the fatty acid composition in SBO: CLO (1:1), the significant incorporated fatty acid was only DHA compared with the control. Transesterification did occur in parallel with hydrolysis, or % of free fatty acids (FFA) removed. FFA for CLO: SBO (1:1), (2:3) and (3:2) were 2.5%, 2.6% and 2.6%, respectively. Both three ratios of transesterified blends reduced the saturated fatty acid composition compared with the control. Only CLO: SBO (3:2) showed the obvious result in incorporation of n-3 PUFA from CLO into SBO. Thus, CLO: SBO (3:2) blend should be the most appropriate ratio to be used in the transesterification to yield high percentage of n-3 PUFA in SBO.

## ABSTRAK

Dalam sumbangan mempertingkatkan kualiti nutrisi dan fungsi bagi minyak kacang soya, kajian terhadap transesterifikasi dengan penggunaan enzim antara campuran minyak hati ikan kod (MHIK) dengan minyak kacang soya (MKS) telah dijalankan. Campuran antara kedua-dua minyak ini dibuat mengikut nisbah 1:1, 2:3 dan 3:2 masing-masing dalam heksana-tepu-air. Enzim yang digunakan adalah lipase 1,3-spesifik daripada *Rhizomucor miehei*. Keputusan yang didapati menunjukkan bahawa MKS mengandungi asid linoleik dengan banyak sementara kebanyakan asid lemak daripada MHIK ialah asid lemak omega-3. Selain itu, transesterifikasi antara MHIK dengan MKS telah berlaku. Transesterifikasi tidak banyak mengubah komposisi asid lemak dalam campuran MHIK dan MKS (1:1), kesan pergabungan asid lemak yang signifikan hanya pada DHA berbanding dengan kawalan. Transesterifikasi berlaku serentak dengan hidrolisis atau peratus penyingkiran asid lemak bebas (%AMB). AMB bagi MHIK : MKS (1:1), (2:3) dan (3:2) masing-masing ialah 2.5%, 2.6% dan 2.6%. Ketiga-tiga campuran MHIK: MKS menghasilkan kandungan asid lemak tepu yang menurun. Pergabungan asid lemak omega-3 hanya dapat menunjukkan keputusan yang jelas dalam MHIK: MKS nisbah 3:2. Dengan ini, campuran 3:2 MHIK: MKS adalah paling sesuai digunakan dalam transesterifikasi untuk mempertingkatkan peratus asid lemak omega-3 dalam MKS.