

อิมัลชันของเลซิทินจากปลาป่นกับการประยุกต์ใช้เป็นตัวจ่ายกรดไขมันไม่อิ่มตัวสูง
ชนิดโอเมก้า-3 แก่เซลล์เลือด



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จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต

สาขาวิชาเทคโนโลยีทางชีวภาพ

บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย

พ.ศ. 2539

ISBN 974-634-205-3

ลิขสิทธิ์ของบัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย

I 1699047x

**FISH MEAL-DERIVED LECITHIN-RICH FAT EMULSION
AND ITS APPLICATION AS A SUPPLIER OF
OMEGA-3 POLYUNSATURATED FATTY ACIDS
TO BLOOD CELLS**

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จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

**A Thesis Submitted in Partial Fulfilment of the Requirements
for the Degree of Master of Science
Program of Biotechnology
Graduate School
Chulalongkorn University
1996
ISBN 974-634-205-3**

Thesis Title Fish meal-derived lecithin-rich fat emulsion and its application as a supplier of omega-3 polyunsaturated fatty acids to blood cells

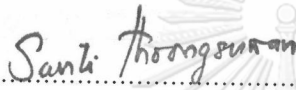
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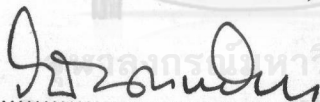
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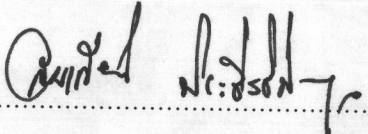
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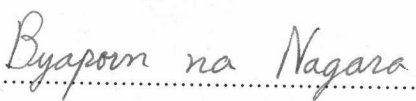
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โสภณา จาตนิลพันธุ์ : อิมัลชันของเลซิทินจากปลาปนกับการประยุกต์ใช้เป็นตัวจ่ายกรดไขมันไม่อิ่มตัวสูงชนิดโอเมก้า-3 แก่เซลล์เลือด (FISH MEAL-DERIVED LECITHIN-RICH FAT EMULSION AND ITS APPLICATION AS A SUPPLIER OF OMEGA-3 POLYUNSATURATED FATTY ACIDS TO BLOOD CELLS) อาจารย์ที่ปรึกษา : ผศ.ดร.วินัย คะห์ลัน, อาจารย์ที่ปรึกษาร่วม : ผศ.ดร.สมเกียรติ ปิยะธีรธิตาวรกุล, 144 หน้า. ISBN 974-634-205-3

จากข้อมูลการศึกษาในมนุษย์พบว่าภายหลังการให้อิมัลชันไขมันที่ใส่เลซิทินจากถั่วเหลืองหรือจากไข่แดงเป็นตัวห่อหุ้ม (อิมัลซิฟายเออร์) ผ่านหลอดเลือดดำเข้าสู่ร่างกายเป็นเวลานาน กรดไขมันไม่อิ่มตัวกลุ่มโอเมก้า-3 บนผนังเซลล์เลือดจะมีปริมาณลดลง การวิจัยครั้งนี้เพื่อศึกษาถึงหนทางการใส่เลซิทินจากปลาทะเลซึ่งมีกรดไขมันโอเมก้า-3 ในปริมาณสูงเป็นสารอิมัลซิฟายเออร์เพื่อประโยชน์ในการยับยั้งการสูญเสียกรดไขมันจำเป็นกลุ่มนี้จากผนังเซลล์เลือด

ผลิตภัณฑ์ปลาทะเลที่ใช้คือปลาปน 4 ชนิดซึ่งมีไขมันและเลซิทินเป็นองค์ประกอบ 11-14 และ 2-3 กรัม/100 กรัมตัวอย่าง ตามลำดับ กรดไขมันที่พบในปลาปนประกอบด้วยกรดไขมันไม่อิ่มตัวหลายตำแหน่งอยู่ 27-31% รวมถึงกรดไขมันอิ่มตัวอยู่ 7-15% ในการศึกษาเลซิทินทำโดยสกัดปลาปนเกรด 1 ด้วยตัวทำละลายอินทรีย์สามชนิดตามลำดับคือ เมธานอล/นอร์มอลเฮกเซน/อะซีโตน เลซิทินที่สกัดได้มีฟอสโฟลิปิดชนิดที่มีโคลีนสูงถึง 66-70% และมีกรดไขมันอิ่มตัวอยู่ 20-23% จากนั้นทำการเตรียมอิมัลชันที่มีเลซิทินจากปลาปน (FM-LRFE) สูง และอิมัลชันอีกสองชนิดที่มีเลซิทินจากไข่แดง (EY-LRFE) และถั่วเหลือง (SY-LRFE) ทั้งสามอิมัลชันมีส่วนของไตรกลีเซอไรด์ต่อเลซิทิน 3:1 โดยน้ำหนัก

ทำการศึกษาการแลกเปลี่ยนกรดไขมันและลิพิดระหว่างเซลล์เลือดกับอิมัลชัน โดยแช่เซลล์เม็ดเลือดแดงกับ FM-LRFE, EY-LRFE หรือ SY-LRFE ที่ระดับความเข้มข้นของเลซิทินระหว่าง 100-300 มิลลิกรัม/เดซิลิตร เป็นเวลา 1 ชม. กับให้มีระดับฮีมาโตคริต 40% ไม่พบการเปลี่ยนแปลงของสัดส่วนโคเลสเตอรอลและฟอสโฟลิปิดของเมมเบรน อย่างไรก็ตามได้พบการเปลี่ยนแปลงของกรดไขมันดังนี้ SY-LRFE และ EY-LRFE ทำให้กรดไขมันไม่อิ่มตัวกลุ่มโอเมก้า-3 บนเมมเบรนเซลล์ลดลง เมื่อแช่กับ SY-LRFE กรดไลโนเลอิก (C18:2 n-6) สูงขึ้นขณะที่คอเลสเตอรอลลดลง ($p < 0.05$) ส่งผลให้สัดส่วน n-3/n-6 ลดลง ($p < 0.05$) ในทางตรงข้าม FM-LRFE สามารถป้องกันการสูญเสียของกรดไขมันโอเมก้า-3 บนเมมเบรนได้ โดยช่วยเพิ่มคอเลสเตอรอล ($p < 0.05$)

สรุปผลจากการศึกษา FM-LRFE สามารถป้องกันการสูญเสียกรดไขมันไม่อิ่มตัวกลุ่มโอเมก้า-3 บนเมมเบรนได้ นอกจากนี้ยังทำหน้าที่เป็นตัวจ่ายที่ติของกรดไขมันเหล่านี้ให้แก่เซลล์เลือดได้ด้วย

ภาควิชา
สาขาวิชา เหนือโนโลยีชีวภาพ
ปีการศึกษา 2538

ลายมือชื่อนิติ โสภณา จาตนิลพันธุ์
ลายมือชื่ออาจารย์ที่ปรึกษา
ลายมือชื่ออาจารย์ที่ปรึกษาร่วม 2538

C626855 : : MAJOR BIOTECHNOLOGY

KEY WORD: LECITHIN/ FISH MEAL/ EMULSION/ LIPOSOME/ OMEGA-3 POLYUNSATURATED FATTY ACID
SOPANA CHATNIBANDHU : FISH MEAL-DERIVED LECITHIN-RICH FAT EMULSION AND
ITS APPLICATION AS A SUPPLIER OF OMEGA-3 POLYUNSATURATED FATTY ACIDS TO BLOOD
CELLS. THESIS ADVISOR : ASST. PROF. WINAI DAHLAN, Ph.D., THESIS CO-ADVISOR :
ASST. PROF. SOMKIAT PIYATIRATTIVORAKUL, Ph.D. 144 pp. ISBN 974-634-205-3

Prolonged intravenous infusion in man of commercial lipid emulsions with lecithins derived from either soya or egg yolk induces a depletion of essential omega-3 polyunsaturated fatty acids (n-3 PUFA) in the circulating blood cell membranes. Our experiment aims to replace the conventional lecithins with n-3 PUFA-rich lecithin derived from marine fish in order to study whether it could maintain the status of these crucial fatty acids of blood cells.

Four grades of fish meal (FM) with crude fat and lecithin contents of respective 11-14 and 2-3 g/100g were used. Their total fatty acids determined by gas chromatographic technique comprised of 27-31% polyenes including 15-19% docosahexaenoic acid (DHA, C22:6 n-3). Lecithin with 25-30% purity was prepared from grade 1 FM after three consecutive organic solvent extractions: methanol/n-hexane/ acetone. The obtained lecithin had choline upto 66-70% with DHA content of 20-23%. FM-derived lecithin-rich fat emulsion (FM-LRFE) as well as other two emulsions with lecithins derived from either egg yolk (EY-LRFE) or soya (SY-LRFE) were prepared by mechanical dispersion. All three emulsions had similar triglyceride to lecithin (TG-LE) ratio of 3:1 (w/w).

The exchanges of fatty acid between blood cells and lecithin-rich fat emulsion were studied *in vitro*. Red blood cells (RBC) with 40% hematocrit were incubated for 1 h with either FM-LRFE, EY-LRFE or SY-LRFE at the lecithin concentrations of 100-300 mg/100 ml incubation mixture. Neither emulsion affected blood cell membrane cholesterol to phospholipid ratio. However, membranes' n-3 PUFA was alternated after the incubations with SY-LRFE and EY-LRFE. Incubating with SY-LRFE, membrane linoleic acid (C18:2 n-6) accumulated whereas DHA dropped leading to a marked reduction of n-3/n-6 PUFA ratio ($p < 0.05$). By contrast, FM-LRFE provided DHA to RBC and raised membrane n-3 PUFAs significantly ($p < 0.05$).

In conclusion, FM-LRFE not only prevents the loss of n-3 PUFA from blood cells but also acts as a good n-3 PUFA supplier.

ภาควิชา.....

สาขาวิชา.....เทคโนโลยีทางชีวภาพ.....

ปีการศึกษา..... 2538.....

ลายมือชื่อนิสิต.....โสภณา จงคุณิฉพันธ์.....

ลายมือชื่ออาจารย์ที่ปรึกษา.....

ลายมือชื่ออาจารย์ที่ปรึกษาร่วม.....

ACKNOWLEDGEMENT



I wish to express my deep gratitude and sincere appreciation to my advisor, Assistant Professor Dr. Winai Dahlan for his excellent supervision, instruction, advice, guidance and encouragement throughout this thesis. I would like to express my gratefulness to my co-advisor, Assistant Professor Dr. Somkiat Piyatiratitivorakul for his useful suggestions and full encouragement.

My sincere gratitude is also extended to Dr. Sumate Tantratian, Associate Professor Dr. Wichai Cherdchewasart and Assistant Professor Dr. Byaporn na Nagara for serving as thesis committee, for their valuable comments and also useful suggestions.

My acknowledgement is also expressed to Fats and Oils Research Center (FORC), Faculty of Allied Health Sciences, Chulalongkorn University for their chemical and instruments supported throughout my two years of this thesis and I would like to thank the Departments of Clinical Chemistry and Clinical Microscopy, Faculty of Allied Health Sciences, Chulalongkorn University for the access to use some instruments that are necessary for my thesis.

I am also grateful for the financial support of the National Science and Technology Development Agency and FORC during my study.

Sincere thanks are also expressed to all the friends of the Biotechnology Programme and the members of the Faculty of Allied Health Sciences, Chulalongkorn University for their assistance and friendship.

Lastly but most importantly, I am greatly indebted to my father, mother, my brother and everybody in my families for their unlimited love support and understanding.

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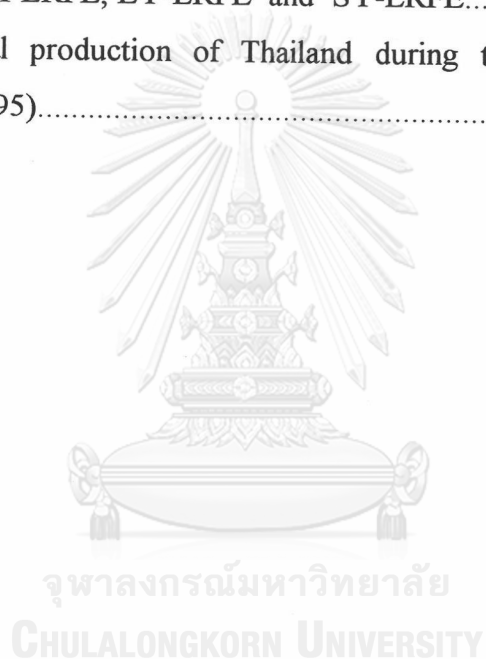
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ABBREVIATIONS

AA	=	arachidonic fatty acid
AOAC	=	American's Oil Association of Chemists
BHT	=	2,6-di-tert-butyl-4-methylphenol
BNF	=	British Nutrition Foundation
°C	=	degree Celcius
CHOL:PL	=	cholesterol to phospholipid ratio
DHA	=	docosahexaenoic acid (C22:6 n-3)
dl	=	decilitre (100 ml)
E	=	ethanol
EY-LRFE	=	egg yolk-derived lecithin-rich fat emulsion
FA	=	fatty acid
FAMES	=	fatty acid methyl esters
FM	=	fish meal
FM-LRFE	=	fish meal-derived lecithin-rich fat emulsion
FORC	=	Fats and Oils Research Center, Chulalongkorn University
g	=	gram
G-1 FM	=	grade 1 fish meal
G-2 FM	=	grade 2 fish meal
G-3 FM	=	grade 3 fish meal
G-4 FM	=	grade 4 fish meal
GRAS	=	generally recommended as safe
H	=	hexane
h	=	hour
IS	=	internal standard
LA	=	linoleic acid
LE	=	lecithin
LPC	=	lysophosphatidylcholine

M	=	methanol
mg	=	milligram
min	=	minute
ml	=	millilitre
μl	=	microlitre
MT	=	metric ton
MUFA	=	monounsaturated fatty acid
n-3	=	omega 3
n-6	=	omega 6
PA	=	phosphatidic acid
PC	=	phosphatidylcholine
PE	=	phosphatidylethanolamine
PG	=	phosphatidylglycerol
PI	=	phosphatidylinositol
PL	=	phospholipids
PL-FA	=	phospholipids fatty acids
PS	=	phosphatidylserine
PUFA	=	polyunsaturated fatty acid
r ²	=	coefficient of determination
RBC	=	red blood cell or erythrocytes
S.D.	=	standard deviation
sec	=	second
SFA	=	saturated fatty acid
SM	=	sphingomyelin
SY-LRFE	=	soya-derived lecithin-rich fat emulsion
TG	=	triacylglycerols or triglycerides
TG-FA	=	triglycerides fatty acids
TLC	=	thin-layer chromatography
TMAC	=	Thai Ministry of Agriculture and Cooperatives
TPN	=	total parenteral nutrition