



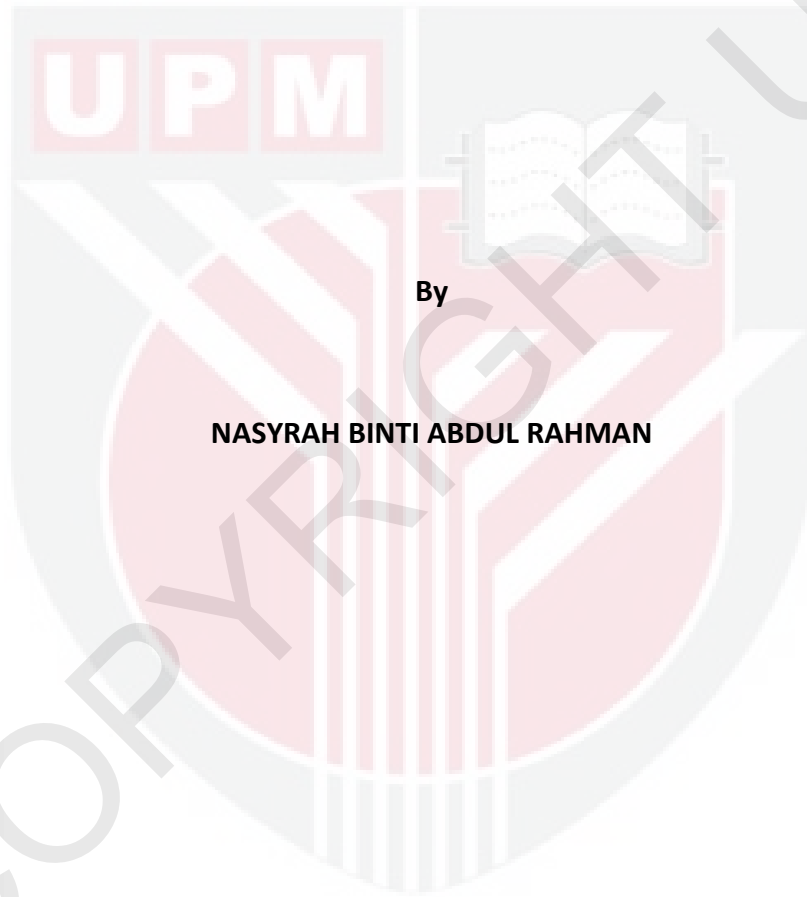
UNIVERSITI PUTRA MALAYSIA

CHARACTERIZATION OF MONO- AND DIACYLGLYCEROL FROM PLANT AND ANIMAL SOURCES BY GAS CHROMATOGRAPHY AND DIFFERENTIAL SCANNING CALORIMETRY TECHNIQUES

NASYRAH BINTI ABDUL RAHMAN

IPPH 2012 5

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SOURCES BY GAS CHROMATOGRAPHY AND DIFFERENTIAL SCANNING CALORIMETRY
TECHNIQUES**



By

NASYRAH BINTI ABDUL RAHMAN

**Thesis Submitted to the School Graduate Studies, Universiti Putra Malaysia, in
Fulfillment of the Requirements for the Degree of Master of Science**

November 2012

DEDICATIONS

I dedicate this dissertation to ibu and ayah for instilling the importance of hard work and higher education, and also to my siblings Anas, Arif, Mahirah, Afiq and Raihana for all the love and happiness in the world, may you also be motivated and encouraged to reach your dreams.

Thank you very much for everything



Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Masters of Science

**CHARACTERIZATION OF MONO- AND
DIACYLGLYCEROL FROM PLANT AND ANIMAL
SOURCES BY GC AND DSC TECHNIQUES**

By

NASYRAH BINTI ABDUL RAHMAN

November 2012

Chair: En. Dzulkifly Bin Mat Hashim

Institute: Halal Products Research Institute

Mono- (MAG) and di-acylglycerols (DAG) or coded as E471 in the food labelling could be derived from either plant or animal lipid materials. From the religious perspective, use of lard based ingredients is not allowed for Muslim consumers. Hence, the objective of this study is to characterize lipid sources used to derive MAG and DAG based on fatty acid and thermal analysis data. This would lead to a simple and efficient method that could ascertain the source of the lipid used to formulate the MAG and DAG. In this study, MAG and DAG of both plant (palm oil, soybean oil, rapeseed oil, and sunflower oil) and animal based lipids (lard, beef fat and goat fat) were synthesized according to a chemical glycerolysis method catalyzed by sodium hydroxide. MAG and DAG of individual lipid were isolated and purified using the standard column chromatography method and subjected to fatty acid analysis by gas chromatography

(GC) and thermal analysis by differential scanning calorimetry (DSC). Principal component analysis (PCA) are also used as tool to discriminate MAG and DAG derived from animal and plant based lipid based on fatty acid and thermal analysis data for halal authentication purposes. In addition to these, analysis of commercially available emulsifiers is also performed in order to find out whether they are formulated from non-halal fat such as lard. The application of PCA to the fatty acid data showed that it was possible to distinctly classify MAG and DAG of plant lipids to those derived from animal fats. DSC analysis showed that individual thermodynamic parameters in the cooling profiles of MAG and DAG derived from each lipids is not identical in many respects such as the onset of the first crystallization and pattern of cooling profiles. As such, they can be used as finger prints to identify MAG and DAG derived from different lipid sources. The application of PCA to the data collected from the individual instrumental technique showed that it was possible to distinctly classify MAG and DAG of plant lipids from those derived from animal fats. Meanwhile, analysis of commercial samples using GC and DSC techniques showed that none of the commercial emulsifiers tested was found to possess any similarity to laboratory prepared lard based emulsifiers.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Sarjana Master Sains

MENKARAKTERISTIK MONO- DAN DI-ASILGLISEROL DARIPADA SUMBER LEMAK TUMBUHAN DAN HAIWAN MENGGUNAKAN TEKNIK GAS KROMATOGRAFI (GC) DAN KALORIMETER PENGIMBASAN KEBEZAAN (DSC)

Oleh

NASYRAH BINTI ABDUL RAHMAN

November 2012

Pengerusi: En. Dzulkifly Bin Mat Hashim

Institut: Institut Penyelidikan Produk Halal

Mono- (MAG) dan di- asilgliserol (DAG) atau dikodkan sebagai E471 dalam pelabelan makanan boleh dihasilkan dari sumber lemak tumbuhan dan haiwan. Dari perspektif agama, penggunaan bahan berasaskan haiwan tidak dibenarkan bagi pengguna Islam. Justeru itu, objektif kajian ini adalah untuk mengkarakteristik sumber lemak yang digunakan untuk mensintesis MAG dan DAG berdasarkan data asid lemak dan data analisis terma. Kajian ini akan menghasilkan kaedah yang mudah dan efisien untuk menentukan sumber lemak yang digunakan untuk mensintesis MAG dan DAG. Dalam kajian ini, MAG dan DAG disintesis dari sumber lemak tumbuhan (sawit, kacang soya, biji sesawi, bunga matahari) dan haiwan (lemak babi, lemak lembu dan lemak kambing) melalui reaksi gliserolisis kimia menggunakan natrium hidroksida sebagai pemangkin. MAG dan DAG yang dihasilkan daripada setiap jenis lemak telah

diasingkan dan dituliskan menggunakan kaedah kromatografi turus dan dianalisis menggunakan gas kromatografi (GC) untuk mendapatkan data asid lemak dan analisis kalorimeter pengimbasan kebezaan (DSC) untuk mendapatkan profil terma. Analisis komponen prinsipal (PCA) juga diaplikasikan berdasarkan data komposisi asid lemak dan data profil terma untuk mengklasifikasi MAG/DAG berasal dari lemak tumbuhan dan haiwan. Di samping itu, analisis pengemulsi komersial juga dijalankan untuk mengetahui sama ada sampel komersial diformulasikan daripada lemak yang tidak halal seperti lemak babi. Aplikasi PCA terhadap data asid lemak menunjukkan bahawa MAG dan DAG yang diperbuat daripada lemak haiwan dan tumbuhan boleh diklasifikasikan dengan jelas. Analisis kalorimeter pengimbasan kebezaan (DSC) menunjukkan bahawa parameter termodinamik individu dalam profil penyejukan MAG dan DAG yang diperolehi daripada setiap lipid adalah tidak sama dalam banyak aspek seperti permulaan penghabluran pertama dan corak profil penyejukan. Oleh itu, mereka boleh digunakan sebagai profil yang unik untuk mengenal pasti MAG dan DAG diperolehi dari sumber lipid yang berbeza. Sementara itu, analisis pengemulsi komersial menunjukkan bahawa tiada daripada pengemulsi komersial yang diuji mempunyai apa-apa persamaan dengan pengemulsi berasaskan lemak babi yang dihasilkan di dalam makmal.

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I certify that a Thesis Examination Committee has met on 21 November 2012 to conduct the final examination of Nasyrah binti Abdul Rahman on her thesis entitled **“Characterization of Mono- and Diacylglycerol from plant and animal sources by GC and DSC techniques”** in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Masters of Science degree.

Members of the Thesis Examination Committee were as follows:

Fatimah Abu Bakar, PhD

Professor
Faculty of Food Science and Technology
Universiti Putra Malaysia
(Chairman)

Suhaimi bin Mustafa, PhD

Associate prof
Faculty of Biotechnology and Biomolecular Science
Universiti Putra Malaysia
(Internal Examiner)

Badlishah Sham Baharin, PhD

Associate prof
Faculty of Food Science and Technology
Universiti Putra Malaysia
(Internal Examiner)

Mohamed Elwathig Saeed Mirghani, PhD

Department of Biotechnology Engineering,
International Islamic University Malaysia
(External Examiner)

SEOW HENG FONG, PhD

Professor and Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 21 March 2013

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Masters of Science. The members of the Supervisory Committee were as follows:

Dzulkifly bin Mat Hashim, M Sc

Lecturer

Halal Products Research Institute,
Universiti Putra Malaysia
(Chairman)

Mohammed Nazrim Marikkar, PhD

Senior Lecturer

Faculty of Biotechnology and Biomolecular Science,
Universiti Putra Malaysia
(Member)

BUJANG KIM HUAT

Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.



NASYRAH BINTI ABDUL RAHMAN

Date: 21 November 2012

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