



UNIVERSITI PUTRA MALAYSIA

***CONTAMINATION OF LARD AND OTHER ANIMAL FAT IN PALM
OLEIN USED IN THE FRYING OF MEATS***

KHAIRATUL MUNIRAH BINTI IDARMAWI

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By

KHAIRATUL MUNIRAH BINTI IDARMAWI

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

July 2016

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

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July 2016

Chairman : Professor Amin Bin Ismail, PhD
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A study was conducted to determine the contamination of lard and other animal fats in palm olein used in the frying of meats such as beef, chicken and pork. The meats were fried in the palm olein at 180 °C and the used palm olein were collected and analysed using gas chromatography, high performance liquid chromatography and differential scanning calorimetry. The differential scanning calorimetry heating profiles proved that the existing of the endothermic peak 'X' in the temperature region from 4.7 °C to 6.5 °C, the sharp exothermic curve 'Z' in the temperature region from 4.2 °C to 4.3 °C and the endothermic peak 'B6' in the temperature region from 10.7 °C to 13.9 °C simultaneously, indicated the contamination from the frying of beef, whereas, the presence of the sharp exothermic curve 'Z' in the temperature region from 4.9 °C to 6.6 °C only, was clearly indicated the contamination from the frying of pork. Frying of chicken meat in the palm olein did not obviously influence the heating and cooling profiles of the used palm olein. Thus, differential scanning calorimetry is found to be very useful, safe, fast, sensitive, efficient and reliable instrumental method in determining the fingerprint of lard contamination in the palm olein used in the frying of meats. The Principle Component Analysis of triacylglyceride compositions and the heating profiles were able to classify the palm olein used in the frying of meats into two groups. The first group comprised of the palm olein used in the frying of pork, pork sausages and bacon, whereas, the second group comprised of the palm olein used in the frying of beef and chicken. Therefore, the findings obtained in this study can be applied to the determination and certification of halal status especially in food industries.

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

**PENCEMARAN LEMAK BABI DAN LEMAK HAIWAN LAIN DALAM
MINYAK KELAPA SAWIT YANG DIGUNAKAN UNTUK MENGGORENG
DAGING**

Oleh

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Satu kajian telah dijalankan untuk menentukan pencemaran lemak babi dan lemak binatang lain di dalam minyak kelapa sawit yang digunakan untuk menggoreng daging seperti daging lembu, ayam dan babi. Sampel daging digoreng dalam minyak kelapa sawit pada suhu 180 °C dan minyak kelapa sawit yang telah digunakan dikumpul dan dianalisis dengan menggunakan kaedah kromatografi gas, kromatografi cecair berprestasi tinggi dan kalorimeter pengimbasan perbezaan. Profil pemanasan dari kalorimeter pengimbasan perbezaan telah membuktikan kehadiran serentak satu puncak endotermik 'X' dalam julat suhu daripada 4.7 °C hingga 6.5 °C, satu keluk eksotermik 'Z' dalam julat suhu daripada 4.2 °C hingga 4.3 °C dan satu puncak endotermik 'B6' dalam julat suhu daripada 10.7 °C hingga 13.9 °C menunjukkan pencemaran minyak kelapa sawit tersebut adalah daripada penggorengan daging lembu. Manakala, kehadiran keluk eksotermik 'Z' sahaja telah jelas menunjukkan pencemaran adalah daripada penggorengan daging babi. Penggorengan daging ayam dalam minyak kelapa sawit tidak mempengaruhi profil pemanasan dan penyejukan dalam minyak yang telah digunakan tersebut. Oleh itu, penggunaan alat kalorimeter pengimbasan perbezaan didapati sangat berguna, selamat, pantas, peka, berkesan dan sesuai dalam mengesan kriteria khas yang terhasil daripada pencemaran lemak babi dalam minyak kelapa sawit yang telah digunakan untuk menggoreng daging. Analisis Komponen Utama ke atas komposisi trigliserida dan profil pemanasan dapat mengklasifikasikan minyak kelapa sawit yang telah digunakan untuk menggoreng kepada dua kumpulan. Kumpulan pertama terdiri daripada minyak kelapa sawit yang telah digunakan untuk menggoreng daging babi, sosej babi dan bakan, manakala, kumpulan kedua terdiri daripada minyak kelapa sawit yang telah digunakan untuk menggoreng daging lembu dan ayam. Oleh itu, penemuan yang diperolehi dalam kajian ini boleh diaplikasikan untuk penentuan serta pensijilan status halal terutamanya dalam industri makanan.

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I certify that a Thesis Examination Committee has met on 22 July 2016 to conduct the final examination of Khairatul Munirah bt Idarmawi on her thesis entitled "Contamination of Lard and Other Animal Fat in Palm Olein Used in the Frying of Meats" 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 Master of Science.

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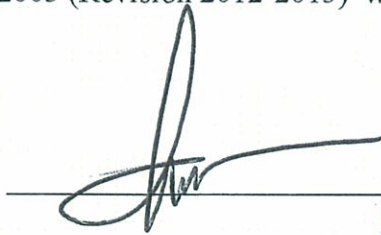
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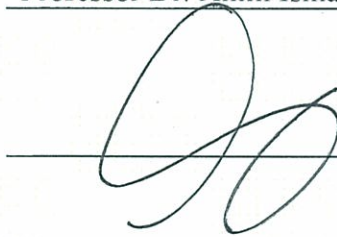
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LIST OF ABBREVIATIONS

ANOVA	Analysis of varians
DSC	Differential scanning clorimetry
DTA	Differential thermal analysis
DV	Dependant variable
EDA	Exploratory data analysis
FA	Fatty acids
FFA	Free fatty acid
IV	Independent variables
MPOB	Malaysian Palm Oil Board
PAEF	Palmitic acid enrichment factor
PCA	Principle component analysis
ppm	Parts per million
TAG	Triacylglycerol
w/w	Weight over weight

CHAPTER 1

INTRODUCTION

1.1 Problem statements

Halal concept is not applicable only for food itself but also for the entire process of food productions. Nowadays, numerous studies have been conducted to explain about the application, understanding and awareness of halal concepts in food production industries. Muslims consumers in Malaysia have begun to question the halal status of the food products from the raw materials, processing, handling and storage, food safety and hygiene, packaging and labelling until the foods that are ready to consume (Talib et al., 2010).

The halal supply chain became one of the important criteria in ensuring the halal status of the final food products other than the animal feeds and the slaughtering process. The food industry players must avoid any cross contamination of non-halal goods in every steps of food processing (Emi Normalina and Harlina Suzana, 2011). Recently, the important of halal integrity which emphasized as the foundation of the halal food industries have been discussed. All parties involved in the halal food industries must take care of the halal food products from being contaminated with non halal food such as pork and lard (Zulfakar et al., 2014).

The issue of pork and all its by-products adulteration and contamination in food are of great concern especially to the Muslims and Jews communities. The Islamic religion is strictly prohibited the consumption of any products contaminated or adulterated with pork and lard based on the order as clearly stated in the Quran that “He has forbidden you only dead animals, and blood, and the swine, and that which is slaughtered as a sacrifice for other than God” (Yusuf Al-Qaradawi, 2013).

In Malaysia, the frying method and the fried food have been chosen by most Malaysians because of changes to the modern lifestyle. Since the growth of the fast food industry, used cooking oil production has also increased. The collection of used cooking oil and its reprocessing has become the profitable business. Of grave concern, the use of cooking oil which has been used in frying various foods including pork is the subject of study. The used cooking oil will be collected, reprocessed, repacked and sold in the market with a cheaper price.

It is also possible that the cooking oil is used for frying of non-halal food could be reused to fry halal food in the same container. Moreover, during the frying process, the contaminated oil could splash on other part of the kitchen area and even contaminate the food being cooked. As discussed earlier, once lard is detected in the oil, it will change the status of the cooking oil from halal to haram. Although these situations may not occur in the Muslims food premises, it has high possibility to be

happened at the halal certified non-Muslim's food premises because of less sensitivity regarding halal principle. The awareness and sensitivity of halal principle in relation to food consumption among non-Muslims in Malaysia is highly influenced by their socio-economic and demographic such as education levels, urban dwellers and religious belief (Golnaz et al., 2010).

On top of that, the issue regarding the management of used cooking oil is not clearly stipulated in any law or guideline. In this situation, the problem will arise when the used cooking oil is indiscriminately collected and used in the manufacturing of recycled cooking oils, soap, perfumes or animal feed without clearly ascertaining the origin of the oil. It has been noticed, this issue of the final products has implication to health and create religious sensitivities. Therefore, the best way is to regulate and restrict collection and reuse of recycled oil.

At present, there are limited numbers of academic publications discussing the contamination of lard or other animal fats in the cooking oil after frying process of foods. Most of the publications focused on the study of lard adulteration in the edible fats and oils. The lard or other animal fats were directly adulterated with edible oils. For instance, the adulteration of lard, randomised lard and other animal fats and vegetable oils such as refined, bleached and deodorised palm olein (Marikkar et al., 2001), canola oil (Marikkar et al., 2002b) and virgin coconut oil (Mansor et al., 2011) had been investigated. On the other hand, the researchers also interested to study the performance of edible fat in the frying of foods such as frying of French fries in the olive oil and palm olein (Tabee et al., 2009). In the scope of halal authentication, lard had been used to fry various types of food such as beef, chicken, fermented soybean and peanut (Marikkar et al., 2003) and also chicken nugget (Marikkar et al., 2010).

Therefore, through this research, a reliable method for determining contamination of lard and other animal fats in palm olein used in the frying of meats has now been developed. The chemical properties such as the fatty acids, triacylglycerols and thermal profiles analysis became the major testing criteria in this research. Data from those parameters had been applied to the statistical evaluations such as the Analysis of Varians (ANOVA) and the Principle Component Analysis (PCA).

1.2 Significant of study

Significantly, the findings obtained from this study can contribute to the four different groups of communities. Firstly, it can increase the profit value in the halal food industries because of the increasing of trust level to the halal status of the final food products. Second, it can help Muslims and non-pork consumers to avoid from consuming any food products that contaminated with lard. Third, the established test procedures and findings obtained from this study can be used as the guideline to the government agencies especially for halal certification and enforcement and also to regulate and restrict collection and reuse of recycled oil. Fourth, for the groups of

researchers, this study can serve as baseline data for future research in halal authentication.

1.3 Objectives

This research has established reliable procedures and laboratory tests in determination of lard and other animal fats contamination in palm olein used in the frying of meats. Therefore, the specific objectives of this study are:

- 1.3.1 To distinguish the fatty acid compositions of palm olein used in the frying of beef, chicken and pork using gas chromatography flame ionization detector (GC-FID).
- 1.3.2 To distinguish the triacylglycerol (TAG) compositions of palm olein used in the frying of beef, chicken and pork using high performance liquid chromatography Reflective Index Detector (HPLC-RID).
- 1.3.3 To distinguish the thermal profiles (Cooling and heating) of palm olein used in the frying of beef, chicken and pork using Difference Scanning Calorimetry (DSC).
- 1.3.4 To determine the source of contamination using classification in the Principle Component Analysis (PCA).

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