Revelation and Science
Vol. 02, No.01 (1433H/2012) 1-8

The Contribution of Science and Technology in Determining the Permissibility (Halalness) of Food Products

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Abstract
Science and technology have always played an important role in the food industry, in ensuring that society's need for safe and good quality food is met in a sustainable way. In recent decades, advances in automated food preparation and packaging technologies have made the mass production of attractively packaged food commercially viable. However, this use of science and technology for commercial gain can sometimes lead to food adulteration, whereby some ingredients that do not comply with *shari'ah* requirements are used in food production. It has been reported, for instance, that some food manufacturers use lard as a substitute for other types of fat in their products because it is relatively cheap and easily available. This is a matter of concern to Muslim consumers, who have to be sure that their foods are *halal* and free from *haram* ingredients. This paper discusses the contribution of science and technology to the detection of *haram* ingredients in food products. It is hoped that this paper will contribute to knowledge in the field of science and *shari'ah*.

Keywords: Science, *Halal*, Food products, Adulteration, Authentication, Technology

Abstrak

Peranan utama sains dan teknologi adalah untuk memastikan keperluan masyarakat terhadap kemampanan kualiti dan keselamatan makanan terjamin. Dalam pada itu, makanan yang berada di pasaran telah bertambah baik dari segi nilai nutrisi, manfaat dan komposisi bagi menjamin kualitinya. Namun, perkembangan ini juga telah mengakibatkan pemalsuan makanan apabila ramuan tertentu yang tidak memenuhi tuntutan *shari'ah* digunakan dalam pemprosesan makanan. Ada pengusaha makanan yang menggunakan lemak babi sebagai ramuan alternatif kerana lebih murah dan mudah didapati. Hal ini sudah tentu mencetuskan perasaan negatif dalam kalangan pengguna Muslim yang perlu memastikan makanan mereka halal dan bebas daripada ramuan haram. Kertas ini akan membincangkan sumbangan sains dan teknologi bagi mengesan ramuan haram dalam produk makanan dan diharap dapat menyumbangkan ilmu pengetahuan dalam bidang sains dan *shari'ah*.

Kata kunci: Sains, *Halal*, Produk makanan, Pemalsuan, Pengesahan, Teknologi

Introduction

Food and its nutritional contents are among the topics that have been discussed in academician and scientist scholar. The improvement of its quality of efficiency has always been debated between both scholars. This is because food in any component that can be consumed to provide nutritional support for the body. Among essential nutrients that are in food include, among other, carbohydrates, protein, fats, vitamins or minerals. The substance is ingested by an organism and assimilated by the organism's cells in an effort to produce energy, maintain life, or stimuli growth.

The determination of food authenticity and the detection of adulteration are major issues in the food industries, because the inappropriate labelling of ingredients can represent a commercial fraud. The incorrect labelling can be a serious matter, especially concerning the presence of potentially allergenic foods. The need to support food labelling has provided the development of analytical techniques for the analysis of food ingredients (Mafra *et al.*, 2007). The major issues concerning authenticity is where

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high value raw materials are substituted with cheaper materials (Al-Jowder *et al.*, 1997) and especially in cases involving 'value-added' products, where the potential financial rewards for substitution of a cheaper ingredients are high (Lai *et al.*, 1995). Detection of food adulterant is important for the protection of wealth and health of consumers (Pouli *et al.*, 2007), as well as for religious concern. In some countries the food manufactures prefer to choose lard as substitute for oil because it is less expensive and easily available (Aida *et al.*, 2005).

The advancement in food science and technology has progressed so much that it is getting more complicated. All sorts of ingredients are used in foods, which are difficult to understand by the consumer unless they are involved directly in the related field. In addition, the task of *halal* authentication cannot depend only on expertise from *shari'ah* alone, but also requires other related technical fields such as food science and technology, chemistry and veterinary science. Besides, *halal* authentication cannot rely solely on physical inspection and documentation anymore, but also by using the latest high sopisticated technology analytical instrumentation.

In Islamic law, *halal* means "allowed", "lawful" or "permitted" (Chaudry and Regenstein, 1994). Any ingredients that are used in food production are either permissible (*halal*) or prohibited (*haram*). The identity of the ingredients in processed or composite mixtures is not always readily apparent and verification that the components are authentic and from sources acceptable to the consumers may be required (Lockley and Bardley, 2000). There is also discussion among the scholars associated with the acquisition of source material, processing, packaging, shipping and so on. In other words, the food chain discussion starts from farm management to consumers plates (from farm to fork). Therefore, the authenticity of *halal* food has raised concern among Muslim consumers throughout the world. This is because adulteration of *haram* or *shubhah* ingredient in food products has been widespread and difficult to be identified with the naked eyes. Muslims are encouraged to investigate through scientific knowledge for the advantages and disadvantages, as well as the wisdom of such prohibition. Thus, this paper will focus on the contribution of science and technology in determination of the permissibility (*halal*ness) of food products.

Issues in *Halal* Food Adulteration

Nowadays, there are many issues in *halal* food industry. Among of that is adulteration in *halal* food products. Adulteration is a legal term for a food product which fails to meet certain standards. Adulteration has been defined as making food or drink less pure by adding another substance to it therefore will lower the quality of food or drink (Oxford Dictionary, 2001). Adulteration of food has ranged from the simple addition of natural compounds to the much more serious case of contaminant with harmful substances (Defernez *et al.*, 1995)

Fats and oils are essential nutrients for human being. Industrially, manufactures have played an important role in the development of different areas of chemical, pharmaceutical, cosmetic, and most importantly, food products. Fats and oils have been liable to adulteration, to a greater or lesser degree since very early time. For food industry, lard still serves as an important ingredient in the formulation of some food products, mainly embedded products. For instance, lard or industrially modified lard could be effectively mixed with other vegetable oils to produce shortenings, margarines and other food oils (Marikkar *et al.*, 2005). However, many studies on nutrition have shown the side effects of some types of fat, like saturated fat found primarily in animal products. Besides, diets rich in lard are known to associate with certain health risk such as hypercholesterolemia and coronary heart disease (Rashood *et al.*, 1996). A survey conducted by Food and Agricultural Organization (FAO) showed that there is significant correlation between dairy and lard intake and the incidents of cancer in different organs such as breast, prostate, rectum, colon, and lungs (Rashood *et al.*, 1995).

As more food has become available in the market, the authenticity of halal food has raised much concern among Muslim consumers throughout the world. Muslims require some protection to ensure that information on food labels and elsewhere presented to them is accurate (Eliasi, 2002). Usually, the ingredient label does not list the origin of the ingredients and the composition (including which contain pork, lard and porcine ingredients). Hidden ingredients from various sources present another serious problem for Muslim consumers (Riaz and Chaudry, 2004). The high demand for transparency in the food industry has enhanced the development of methods for the analysis of *halal* food ingredients (Che Man *et al.*, 2007).

Recently, *halal* authenticity has become of paramount importance issue of major concern in the food industry, as consumers daily come into contact with great variety of foods. Many cases were reported worldwide involving adulteration of *haram* or *shubhah* ingredients in foods productions. In addition, with the advent of science and technology, food had undergone many processes and was transported to different parts of the world which has raised concern among Muslim consumers and led to their curiosity,

as to whether the processed foods contain any *haram* substances. In the last few years, there is an increasing trend in some countries to mix pork and lard in their food products for the purposes of gaining extra economic profit. Methods have been developed for detection of lard in food product formulations, namely cake (Syahariza *et al.*, 2005[a]), chocolate (Che Man *et al.*, 2005[a]), and biscuits (Syahariza *et al.*, 2010), meat (Al-Jowder *et al.*, 1997) ghee and butter (Farag *et al.*, 1983; Lambelet *et al*., 1980; Kowalski 1989), and vegetable oils (Marikkar *et al.*, 2005). Moreover, the fraudulent description of food contents can either be intentional or unintentional. Hence, harmonization of science and Islamic law is very important especially with regard to *halal* authentication to protect consumers from fraud and deception.

Halal and *Haram* Food: An Islamic View

In Islamic law, Muslims have stressed on the importance of the permissibility (*halal*) sources of food and of good quality with comfortable minerals and vitamins as needed to be consumed (Hilal, 2005). Allah SWT has made it compulsory for the Muslim consumers and this matter has been clearly mentioned repetitively in the Quran, *Sunnah*, the consensus of the Muslim jurist (*Ijma'*) and the method of deductive analogy (*Qiyas*). Allah SWT has said in the Holy Quran:

"O ye who believe! Eat of the good things that We have provided for you, and be grateful to God, if it is Him ye worship."

(The Quran 2:172)

These two aspects that are *halal* and best of quality will not only ensure influence the development of human physical wellness and alertness but will also be push a factor that will help to increase the quality of behavior such as *taqwa* (God-fearing) and *syukur* (Gratefulness) toward Allah SWT. In addition, permissible and healthy food also is considered as one of the most important elements for interaction among various ethics, social and religious group. For examples, Muslims want to ensure that their food is *halal*, Jews that there is *kosher* while Hindus and Buddhist and certain other groups that their food is vegetarian (Riaz and Chaudry, 2004).

In Islamic point of view, *halal* means permissible while *haram* refer to prohibited or forbidden. According to Islamic jurisprudence it is defined as something that must be avoided according to Islamic Law (Zuhayli, 1997). For example, the prohibition from eating the flesh of pork and its derivatives as it is a sin and impiety to do so. These rulings have been stated in the Islamic law as guidelines to all of mankind. There would be changes according to place, time and situation. Nevertheless, each difference must be based on the due process of *ijtihad* (decision making process) among Muslim jurist of scholars.

In addition, eating of *haram* materials and using them as adulterants or additives in food products are also forbidden even if it is physically superior in quality and high in demand. This consumption was believed that it would cause unwarranted effect for himself and his family in this world or the hereafter. This is clearly demonstrated in many verses of the Quran and also in *Sunnah*. In surah *al-Maidah*, for example Allah SWT has said:

"Forbidden unto you (for good) are carrion and blood and flesh of the swine, and that over which is invoked the name of other than Allah, and the strangled, and the dead through beating, and the dead through falling from a height, and that which has been killed by (the goring of) horns, and the devoured of wild beasts, unless you have cleansed (by slaughtering) it in the proper, lawful way, while yet there is life in it, and that which has been immolated unto idols. And (forbidden is it) that ye swear by the divine arrows. This is an abomination."

(*The Quran 5:3*)

Then, a saying of the prophet narrated by Jabir RA stated that Muhammad SAW which means:

"That flesh will not enter Paradise which has grown from Haram and all that flesh which has grown from haram, the fire (of hell) is more worthy of it."

(*Musnad Ahmad, Sunan Darimi and Sunan Baihaqi*)

Besides *halal* and *haram*, there are also doubtful things or *mashbooh* in Islamic law. This *mashbooh* can be defined as unsure, unclear and questionable in something due to the differences in scholars' opinions or the presence of undetermined ingredients in a food product. For instance, food was added by animal enzyme or substance from doubtful ingredients into *halal* food products. This is mentioned precisely in the *Sunnah* of the Prophet Muhammad SAW. Narrated An-Nu'man bin Bashir: I heard Allah's Apostle saying:

"Both legal (halal) and illegal (haram) things are evident but in between them there are doubtful (suspicious) things and most of the people have no knowledge about them. So whoever saves himself from these suspicious things saves his religion and his honor. And whoever indulges in these suspicious things is like a shepherd who grazes (his animals) near the Hima (private pasture) of someone else and

at any moment he is liable to get in it. (O people!) Beware! Every king has a Hima and the Hima of Allah on the earth is His illegal (forbidden) things. Beware! There is a piece of flesh in the body if it becomes good (reformed) the whole body becomes good but if it gets spoilt the whole body gets spoilt and that is the heart."

(*Sahih al-Bukhari, hadith no. 49*)

Within the norms of Islamic law, matters that are regarded as *haram* are thus very small in numbers in comparison to matters that are permissible. However, nowadays it must be understood that the margin of used *haram* or *mashbooh* ingredients into *halal* products has been increasing and miserable (Chaudry, 1992). One of the issues is pigs which are animals that are prohibited, being used as additional in food products. The prohibition of this animal is based on several aspects of harmfulness and defectiveness that are caused by the matter itself from either chemical, microbial or psychology (Hawwa, 1994; Sakr, 1991). Among the verses in the Quran that emphasizes the prohibition of pigs can be found in surah *al-Baqarah* where Allah SWT has said:

"He hath only forbidden you dead meat and blood, and the flesh of swine, and that on which any other name hath been invoked besides that of Allah (s.w.t.) but if one is forced by necessity, without willful disobedience, nor transgressing due limits,-then is He guiltless. For Allah is Oft-forgiving Most Merciful."

(The Quran 2:173)

In commenting on the verse of the word 'flesh of swine' or pork meat, al-Zamakhshari states in interpretation of that it also includes lard, skin and derivatives of pig (al-Zamakhsyari, 1998). Although the Quran mentions only the flesh but the pig derivatives and by-products are also prohibited as well. This view is supported by Qurtubi (2006) in *al-Jami' li Ahkam al-Qur'an* which includes lard as a part of the meat. In addition, Ibn Hazm al-Zahiri argued that furs and bones which are derived from pig are also *haram* to be used. However, the skins derived from pigs are permitted when they are tanned. Ibn Hayyan and Dawood however suggest that the prohibition was only meant for meat not the lard and derivatives (al-Andalusi, n.d.).

There are many reasons for the prohibition of pigs and one of the reasons is to protect Muslims from harm. It is submitted; however that only Allah SWT knows the exact reason and the real wisdom as to why pork is prohibited. From that perspective, Muslim scholars have a consensus opinion (*Ijma'*) on prohibition for all part of pig including skin, bone, flesh and its derivatives. This also includes all types of pork, including that of wild boar, although the original reference was to domestic pig thorough the method of *Qiyas* (Hallaq and Wael, 2009).

The Contribution of Science and Technology in Determination the *Halal*ness of Food Products

Science and technology can contribute towards solving the world's food problem by developing various techniques for determining the *halal*ness of food products by improving the quality of such processed foods to keep pace with the rising standards, which applied science can bring in other aspects of modern life. The new and sophisticated techniques have been developed for the authentication study of food products especially in pork and lard adulterants for *halal* purposes.

The detection of pork and lard adulterations faced some technical problems, because an adulterant (pork and lard) consists approximately the similar chemical composition with food products in which they present. To overcome these problems, there are several approaches to detect an adulterant. The first approach is by determining the ratios between some chemical constituents. This approach seems to make sense that any addition in any food products will modify or change these ratio values or will highlight an anomaly in its chemical compositions. The second approach is by searching a specific marker in food products, either chemical constituents or morphological components, which proves the presence of adulterants in food products. The third approach is by using analytical methods derived from physical analysis by taking into account the whole samples to show the adulteration effects on the physical-chemical properties (Cordella *et al.*, 2002).

The analytical methods used for the detection of adulteration of fats and oils specifically lard are based on the differences in the nature and the composition of the major and minor components of the adulterant and those of the unadulterated fats or oils. These methods usually depend on their physical-chemical constants or based on chemical and biological measurements (Kowalski, 1989).

In the analytical field, there are many principal techniques that have been successfully applied to detect and identify *haram* based ingredients adulteration in food. As a result, several analytical methods have been developed for the analysis of pork and lard in food products such as Fourier Transform Infrared (FTIR) spectroscopy, gas chromatography (GC), gas chromatography-mass spectrometry (GC-MS), High pressure liquid chromatography (HPLC),

liquid chromatography-mass spectrometry (LC-MS), differential scanning calorimetry (DSC), electronic nose (EN), DNA-based method, and Enzyme-linked immunosorbent assay (ELISA). Ideally, the analytical method used for detection should be rapid, easy to use and low cost. Table 1 lists some analytical methods used for pork and lard analysis in food and food products.

Table 1: Analytical methods used for analysis of pork and lard in food products (Rohman and Che Man 2012)

Methods	Food Samples	Issue	References
FTIR	Cake formulation	Lard adulteration in shortening	Syahariza *et al*., 2005[b]
	Chocolate and its products	Lard adding	Che Man *et al*., 2005[a]
	Biscuit	Lard adulteration	Syahariza *et al*., 2005[a]
	Edible oil	Lard chracterization	Guillen & Cabo, 1997
	Meat	Lard mixed with other meat	Che Man & Mirghani, 2001
	Meat Meat	Pork identification Lard mixture	Al-Jowder *et al*., 1997 Jaswir *et al*., 2003
HPLC	Meat products	Detection of pork and lard	Saeed *et al*., 1989
	Meat products	Detection of lard	Rashood *et al*., 1996
	Meat Edible oil	Detection of meat adulteration Contamination of lard	Wissiack *et al*., 2003 Marikkar *et al*., 2005
GC	Ghee	Detection of lard in cow and buffalo ghee	Farag *et al*., 1983
	Edible oil	Adulteration of lard in some vegetable oils	Marikkar *et al*., 2005
GCMS	Cooked meat (chicken, pork, beef)	Analysis of volatile flavor	Wittasinghe *et al*., 2001
DSC	Ghee, butter	Adulteration of goat body fat	Lambelet *et al*., 1980
		Adulteration of cow and buffalo ghee by pig	Lambelet, 1983
		Detection of lard and lard contaminated with tallow	Kowalski, 1989
	Edible Oil	Detection of lard and randomized lard in RBD palm oil	Marikkar *et al*., 2001
		Adulteration of RBD palm oil with lipase catalyzed interesterified lard	Marikkar *et al*., 2002a
		Detection of lard in selected food product deep fried ini lard	Marikkar *et al*., 2003
		Monitoring lard, tallow and chicken fat adulteration in Canola oil	Marikkar *et al*., 2002[b]
Electronic Nose	Edible oil	Detection of lard	Che Man *et al*., 2005[b]

DNA based methods	Meat	Spesies speciation	Hunt *et al*., 1997
		Characterization of porcine muscle protein	Chen & Hsieh, 2001
		Characterization of porcine muscle protein	Chen *et al*., 1998
		Species speciation	Lockley & Bradley, 2000
		Detection of pork meat	Montiel-Sosa *et al*., 2000
		Species speciation in raw beef	Ebbehoj & Thomsen, 1991
		Detection of pork and lard	Aida *et al*., 2005
	Food products	Pork identification	Che Man *et al*., 2007
ELISA	Raw ground beef	pork adulteration	Martin *et al*., 1998
	Meat and feed products	Pork quantification	Chen & Hsieh, 2000

**RBD, refined bleached deodorized*

Conclusion

For the conclusion, science and technology has a significant role in the determination of the *halal*ness of food products accurately and effectively. From the *shari'ah* perspective, adulteration from pig sources are prohibition (*haram*) includes all the parts of it such as flesh, skin, lard and also its derivatives. This prohition has been mentioned clearly from Qur'an and Sunnah. Therefore, products that contained lard have to be listed out in details on the food label. This determination in food adulteration via science and technology has a huge contribution and potential to solve the *halal* food products issues, especially as far as authentication and verification are concerned. Several modern scientific techniques have been developed to ensure the *halal*ness of food production. For instance, FTIR, GC, HPLC, GC-MS, LC-MS, DSC, Electronic Nose and others. Muslim researchers should have an urge to explore the detection techniques in food adulteration in order to protect Muslim consumers from fraud and to ensure that the integrity of *halal* is upheld.

REFERENCES

Aida, A.A., Che Man, Y.B., Wong, C.M.V.L., Raha, A.R., and Son, R. "Analysis of raw meats and fats of pigs using polymerase chain reaction for halal authentication." *Meat Science*. 2005, 69: 47-52.

Al-Jowder, O., Kemsley, E.K., and Wilson, R.H. "Mid infra red spectroscopy and authenticity problems in selected meats: a feasibility study." *Food Chem*. 1997. 59 (2): 195-2012.

Andalusi, A.H. Tafsir al-Bahr al-Muhit. vol. 2. Beirut. *Dar al-Kutub al-'Ilmiyyah. n.d. Bukhari. Sahih Bukhari*. 8 vols. Istanbul: al-Maktabah al-Islamiyah. (Trans.) Muhammad Muhsin Khan. Lahore. Kazi Publication. 1979.

Chaudry, M.M. "Islamic food laws: philosophical basis and practical implications." *Food Technol*. 1992, 46: 92-104.

Chaudry, M.M., and Regenstein, J.M. "Implications of biotechnology and genetic engineering for kosher and halal foods." *Trends in Food Science & Technol*. 1994, 5: 165-168.

Che Man, Y.B. and Mirghani, M.E.S. "Detection of lard mixed with body fats of chicken, lamb, and cow by fourier transform infrared spectroscopy." *J. Am. Oil Chem. Soc*. 2001, 78: 753-761.

Che Man, Y.B, Syahariza, Z.A., Mirghani, M.E.S., Jinap, S., and Bakar, J. "Analysis of potential lard adulteration in chocolate and chocolate products using fourier transform infrared spectroscopy." *Food Chem*. 2005a, 90: 815-819.

Che Man, Y.B., Aida, A.A., Raha, A.R., and Son, R. "Identification of pork derivatives in food products by species-specific polymerase chain reaction (PCR) for halal verification, Food Control." 2007, 18: 885-889. (tittle of journal not mention)

Che Man, Y.B., and Setyowati, G. "Application of fourier transform infrared spectroscopy to determine free fatty acid contents in palm olein." *Food Chem*. 1999, 66: 109-114.

Che Man, Y.B., Gan, H.L., NorAini, I., Nazimah, S.A.H., and Tan, C.P. "Detection of lard adulteration in RBD palm olein using an electronic nose." *Food Chem*. 2005b, 90: 829-835.

Chen, F. C., and Hsieh, Y. H." Detection of pork in heat-processed meat products by monoclonal antibody-based ELISA." *J. Assoc. Off. Anal. Chem*. 2000, 83: 79-85.

Chen, F.C., and Hsieh, Y.H. "Separation and characterization of a porcine-specific thermostable muscle protein from cooked pork." *J. Food Science*. 2001, 66: 799-803.

Chen, F.C., Hsieh, Y.H., and Bridgman, R.C. "Monoclonal antibodies to porcine thermal-stable muscle protein for detection of pork in raw and cooked meat". *J. Food Science*. 1998, 63: 201-205.

Cordella, C., Moussa, I., Martel, A.C., Sbirrazzuoli, N., and Cuvelier, L.L. "Recent developments in food characterization and adulteration detection: technique-oriented perspectives." *J. Agric. Food Chem.* 2002, 50: 1751-1764.

Defernez, M., Kemsley, E.K., and Wilson, R.H. "The use of infra red spectroscopy and chemometrics for the authentication of fruit purees." *J. Agric. Food Chem*. 1995, 43(1): 109-113.

Ebbehoj K.F. and Thomsen, P.D. "Species differentiation of heated meat products by DNA hybridization." *Meat Science*. 1991, 30: 221-234.

Eliasi. J.R. "Kosher and halal: religious observances affecting dietary intakes." *J. Am. Dietetic Assoc*. 2002, 101: 911-913.

Farag, R.S., Abo-raya, S.H., Ahmed, F.A., Hewedi, F.M., and Khalifa, H.H. "Fractional crystallization and gas chromatographic analysis of fatty acids as a means of detecting butterfat adulteration," *J. Am. Oil Chem. Soc.* 1983, 60: 364- 366.

Guillen, M.D., and Cabo, N. "Characterization of edible oils and lard by fourier transform infrared spectroscopy. Relationships between composition and frequency of concrete bands in the fingerprint region." *J. Am. Oil Chem.* Soc. 1997, 74: 1281-1286.

Hallaq and Wael B. *An Introduction of Islamic Law*. Cambridge. University Press. 2009.

Hawwa, S. al-Islam. Misr. Dar al-Salam. 1994. *Hilal H.J. Al-At'imah wa al-Asyribah fi al-Sunnah al Nabawiyyah*. Beirut. Dar al-Fikr. 2005.

Hunt, D.J., H.C. Parkes and I.D. Lumley. "Identification of the species of origin of raw and cooked meat products using oligonucleotide probes." *Food Chem*. 1997, 60: 437-442.

Indrasti, D., Che Man, Y.B., Mustafa S., Hashim, D.M. "Lard detection based on fatty acids profile using comprehensive gas chromatography hyphenated with time-of-flight mass spectrometry." *Food Chem*. 2010, 122: 1273-1277.

Jaswir, I., Mirghani, M.E.S., Hassan, T.H., and Mohd Said, M.Z. "Determination of lard in mixtures of body fats of mutton and cow by Fourier transform-Infra red (FT-IR) spectroscopy," *J. Oleo Science*. 2003, 52: 633-638.

Kowalski, B., 1989. "Sub-ambient differential scanning calorimetry of lard and lard contaminated by tallow." *Inter. J. Food Sci. Technol*. 1989, 24: 415-420.

Lai, Y.W., Kemsley, E.K., and Wilson, R.H., 1995. "Quantitative analysis of potential adulterants of extravirgin olive oil using infrared spectroscopy." *Food Chem*. 1995, 53: 95-98.

Lambelet, P., Singhal, O.P., and Ganguli, N.C. "Detection of goat body fat in ghee by differential thermal analysis." *J. Am. Oil Chem. Soc*. 1980, 64: 100-105.

Lambelet P. "Detection of pig and buffalo body fat in cow and buffalo ghee by differential scanning calorimetry." *J. Am. Oil Chem. Soc.* 1983, 60: 1005-1008.

Lockley, A. K. and Bardley, R. G. DNA-based methods for food authentication. Trends in Food Science and Technology. 2000, 11: 67-77.

Mafra, I., Ferreira, I. M. P. L. V. O., Beatriz, M., and Olieviera, P. "Food authentication by PCR-based methods." *European Food Research Technol*. 2007, 227: 649-665.

Marikkar, J.M.N. Ghazali, H.M., Che Man, Y.B., Peiris, T.S.G., and Lai, O.M. "Distinguishing lard from other animal fats in admixtures of some vegetable oils using liquid chromatographic data coupled with multivariate data analysis." *Food Chem.* 2005, 91: 5-14.

Marikkar, J.M.N., Che Man, Y.B., Ghazali, H.M., and Lai, O.M. "The use of cooling and heating thermograms for monitoring of tallow, lard and chicken fat adulterations in canola oil." *Food Research International*. 2002b, 35: 1007-1014.

Marikkar, J.M.N., Ghazali, H.M., Long, K., and Lai, O.M. "Lard uptake and its detection in selected food products deep-fried in lard." *Food Research International*. 2003, 36: 1047-1060.

Marikkar, J.M.N., Lai, O.M., Ghazali, H.M., and Che Man, Y.B. "Detection of lard and randomized lard as adulterants in refined-bleached-deodorized palm oil by differential scanning calorimetry". *J. Am. Oil Chem. Soc.* 2001, 78 (11): 1113-1119.

Marikkar, J.M.N., Lai, O.M., Ghazali, H.M., and Che Man, Y.B. "Compositional and thermal analysis of RBD palm oil adulterated with lipase-catalyzed interesterified lard." *Food Chem.* 2002a,76: 249-258.

Martin, D. R., Chan, J., & Chiu, J. Y. "Quantitative evaluation of pork adulteration in raw ground beef by radial immunodiffusion and enzyme-linked immunosorbent assay." *J. Food Protection*. 1998, 61: 1686-1690.

Montiel-Sosa, J.F., Ruiz-Pesini, E., Montoya, J., Roncales, P., Lopez-Perez, M.J., and Perez-Martoz, A. "Direct and highly species-specific detection of pork meat and fat in meat product by PCR amplification of mitochondrial DNA." *J. Agr. Food Chem.* 2000, 38: 497-501.

Oxford Advanced Learner's Dictionary. 6th Edition, Edited by Wehmeier, S, Oxford. University Press. 2001.

Poulli, K.I., Mousdis, G.A., and Georgiou, C.A. "Rapid synchronous fluorescence method for virgin olive oil adulteration assessment." *Food Chem.* 2007, 105: 369-375.

Qurtubi, al. al-Jami' li Ahkam al-Quran. vol. 13. Lebanon. Mu'assasah al-Risalah. 2006.

Rohman & Y. B. Che Man: "Analysis of Pig Derivatives for Halal Authentication Studies", *Food Reviews International*. 2012, 28:1, 97-11.

Rashood, K. A., Shaaban, R. R. A., Moety, E. M. A., and Rauf, A. "Triacylglycerols-profiling by high performance liquid chromatography: a tool for detection of pork fat in processed foods". *J. Liq.Chromatogr.* 1995, 18: 2661-2673.

Rashood, K.A., Shaaban, R.R.A., Moety, E.M.A., Rauf. "A. Compositional and thermal characterization of genuine and randomized lard: A comparative study." *J. Am. Oil Chem. Soc.* 1996, 73: 303-309.

Riaz, M.N. and Chaudry, M.M. *Halal Food Production.* London. CRC Press. 2004.

Saeed, T., Ali, S.G., Rahman, H.A., and Sawaya, W.N. "Detection of pork and lard as adulterants in processed meat: liquid chromatographic analysis of derivatized triglycerides." *J. Assoc. Off. Anal. Chem.* 1989, 72(6): 921-925.

Sakr, A.H. "Pork: Possible Reasons for its Prohibition. Lombard. Foundation for Islamic Knowledge. 1991.

Syahariza, Z.A. Che Man, Y.B., Mirghani, M.E.S., Jinap, S. and Bakar, J. "Analysis of potential lard adulteration in chocolate and chocolate products using fourier transform infrared spectroscopy". *Food Chem.* 2005a, 90: 815-819.

Syahariza, Z.A., Che Man, Y.B., and Rohman A. "Discrimination analysis of selected edible fats and oils and those in biscuit formulation using FTIR spectroscopy." *Food Analytical Method.* 2010, 4: 404 409.

Syahariza, Z.A., Che Man, Y.B., Selamat J., and Bakar J. "Detection of lard adulteration in cake formulation by fourier transform infrared (FTIR) spectroscopy." *Food Chem.* 2005b, 92: 365-37.

Wissiack, R., D. L. Calle B., Bordin, G., and Rodriguez. A.R. "Screening test to detect meat adulteration through the determination of hemoglobin by cation exchange chromatography with diode array detection." *Meat Science*. 2003, 64(4): 427-32.

Wittasinghe, M., Vasanthan, T., Temelli, F., and Swallow, K. "Volatile flavor composition of cooked by product blends of chicken, beef, and pork: a quantitative GC-MS investigation". *Food Research International.* 2001, 34: 149-158.

Zamakhsyari, al-. al-Kasysyaf. vol. 1. Misr: Maktabah al-'Abikan. 1998. *Zuhayli, Wahbah al-. Ahkam al-Mawad al-Najisah wa al-Muharramah fi al-Ghiza' wa al-Dawa'*. Damsyiq: Dar al-Maktabi. 1997.

Article history
Received: 25/08/2011
Accepted: 22/04/2012