

IDENTIFICATION OF PORCINE-BASED SOURCE IN CAPSULE BY USING
FTIR-ATR AND AWARENESS OF MUSLIM CONSUMER ABOUT THE HALAL
AUTHENTICATION

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UNIVERSITI TEKNOLOGI MALAYSIA

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AUTHENTICATION

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*Dedicated to my most loved husband,
Ma, Aboh, parents, my dearest friend, my caring supervisor and all my course mates*

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ABSTRACT

The demand for pharmaceutical products is growing and this development requires an effective method for detecting porcine (pork-based sources) in the products. This study has three main objectives. First, to investigate the halal issue in pharmaceutical products. Second, to find out the porcine-based sources in the samples using the scientific method in combination with Fourier Transform Infrared Spectroscopy (FTIR) and Attenuated Total Reflectance (ATR) and finally to determine the level of awareness, understanding and knowledge about the use of porcine-based sources in the pharmaceutical products from the respondents among biology students. The main method of this study used was the FTIR-ATR, and supported by quantitative data. FTIR-ATR was used to study porcine sources inside the capsule. Meanwhile, the quantitative data was used to assess the consumers' level of awareness, knowledge and understanding of halal authentication. A total of 13 samples of gelatin from different sources were used in this study. Background samples were determined in the infrared region between $400\text{-}650\text{cm}^{-1}$ at 32 times the wavelength of the examination and resolution of 4 cm^{-1} . The study had found that the major functional groups in spectroscopy were the amino group (NH) and carbonyl group (C=O). All the spectra samples showed the same kind due to the similarity of key components, namely gelatin. The study had also found that level of awareness, knowledge and understanding of the majority of respondents about halal pharmaceutical products was high. This was evidenced by the mean level awareness of 3.52 and mean level knowledge and understanding of 3.55. Instrument for ancillary method was a questionnaire which was adapted from the 'Dimension of Halal Purchase Intention' questionnaire. Data collected from the questionnaires of 91 respondents were analyzed descriptively using (SPSS) software version 16.0.

ABSTRAK

Permintaan terhadap produk farmaseutikal halal semakin meningkat dan perkembangan ini memerlukan satu kaedah yang efektif bagi mengesan porsin (sumber berasaskan babi) dalam produk tersebut. Kajian ini mengandungi tiga objektif utama. Pertama, untuk menyiasat tentang isu halal dalam produk farmaseutikal. Kedua, untuk mengetahui sumber berasaskan babi dalam sampel menggunakan kaedah saintifik dengan kombinasi *Fourier Transform Infrared Spectroscopy (FTIR)* dan *Attenuated Total Reflectance (ATR)* dan akhirnya untuk menentukan tahap kesedaran, kefahaman dan pengetahuan mengenai penggunaan sumber babi dalam produk farmaseutikal daripada responden pelajar biologi. Kajian ini menggunakan kaedah utama, iaitu FTIR-ATR dan disokong oleh data kuantitatif. FTIR-ATR digunakan untuk mengkaji sumber porsin dalam kapsul. Manakala, data kuantitatif digunakan bagi mengukur tahap kesedaran, pengetahuan dan kefahaman pengguna mengenai pengesanan halal. Sebanyak 13 sampel gelatin daripada sumber yang berlainan telah digunakan dalam kajian ini. Latar belakang sampel telah ditentukan pada kawasan inframerah di antara $400\text{-}650\text{cm}^{-1}$ sebanyak 32 kali pemeriksaan dan resolusi panjang gelombang sebanyak 4cm^{-1} . Kajian mendapati keputusan kumpulan berfungsi utama yang terdapat dalam spektroskopi ialah kumpulan amino (N-H) dan kumpulan karbonil (C=O). Semua sampel spektra menunjukkan jenis yang sama disebabkan oleh persamaan komponen utama, iaitu gelatin. Kajian mendapati tahap kesedaran, pengetahuan dan kefahaman majoriti responden terhadap produk farmaseutikal halal adalah tinggi. Hal ini dibuktikan dengan nilai min tahap kesedaran ialah 3.52 manakala tahap pengetahuan dan kefahaman ialah 3.55. Instrumen bagi kaedah sampingan adalah soal selidik yang telah diadaptasi daripada soal selidik 'Dimension of Halal Purchase Intention'. Data yang dikumpul daripada borang soal selidik terhadap 91 responden dianalisis secara deskriptif menggunakan perisian (*SPSS*) versi 16.0.

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LIST OF ABBREVIATIONS

ACTH	-	Adrenocorticotrophic hormone follicle
CFTR	-	Cystic fibrosis transmembrane conductance regulator
DSC	-	Differential scanning calorimetric
ELISA	-	Enzyme-Linked Immunosorbent Assay
FTIR	-	Fourier Transform Infrared Spectroscopy
GC	-	Gas chromatographic
GMO	-	Genetically modified organism
HPLC	-	High Performance Liquid Chromatographic
JAKIM	-	Department of Islamic Development's
MS2424:2010	-	Malaysian Standard: Halal Food Production, Preparation and Storage - General Guidelines
OIC	-	Organization of Islamic Conference
PCR	-	Polymerase Chain Reaction
RFLP	-	Restriction fragment length polymorphism
RBD	-	Refined, bleached, deodorized
SAW	-	Surface acoustic wave
S.A.W	-	Sallallahu 'Alaihi Wassalam
S.W.T	-	Subhanahu Wa Taala
SPSS	-	Stastical Package of Social Sciences
TRH	-	Thyrotropin-releasing hormone

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INTRODUCTION

CHAPTER 1

1.1 Preliminary Study

In the modern world, the advance of science and technology has led to the development in the food industry, medicine and household products. The increasing of Muslim population has resulted in more demand of food products, medicines, and other essential goods. Thus, reducing of manufacturing costs is the best strategy to increase the production level of the products. Surprisingly, the star of this issue today is pig. Pig is one of the great sources that can be used for reducing the production cost economically. It was applied in the industries since years ago. Pig is the animal that has great influence to the industry in the areas of food production, pharmaceutical product and accessory items. Every inch of the pig part can be used to produce a variety of products without waste (Muhammad, 2011). In the pharmaceutical industry, pig is well known as porcine. Presently, the use of porcine in the product was a big and critical issue due to the Muslim consumers and other religions like Jewish and Hinduism (Hashim *et al.*, 2010). There were a lot of essential products nowadays in the doubted status of halal due to this pig issue. The usage of materials that has pig influence has caused controversy for users especially to Muslim consumers whereby, Islam forbids its followers for consuming the items,

which derived from illegal element such as pig and its derivatives. In context of Islam, the foods including any medicine have to follow the principles and specific rules as a guideline for determining the halal status of the product.

1.2 Background of the Study

Malaysia is a multi-racial country with various ethnic groups whereby, the issues of halal and haram play a great role in the industries especially in Muslim daily product. Allah S.W.T has made compulsory for all Muslims to consume food that is halal (lawful) and good quality with sufficient minerals and vitamins as needed. As stated by Mohd Yunus *et al.* (2010), there are two aspects of halal, whereby the best quality of the product will not only ensure physical health, but also be the push factors that will increase the quality of *taqwa* (God-fearing) and *syukur* (Gratefulness) towards Allah S.W.T. This matter has been clearly mentioned in the holy Qur'an.

“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.”

(Al-Baqarah, 2:172)

In recent years, the issues of halal in pharmaceutical, daily product, cosmetic, beverages as well as food are very contemporary, sensitive and controversial. The aim for the pharmaceutical industry is only to produce drugs for the medical treatment without seriously caring about the issue of non-halal products for Muslim consumer. Thus, halal awareness in non-food products continues to rise due to the halal authenticity which permitted under shari'ah law is a major issue that has been a concern. Besides, the falsification of food contents on product labels is also becoming a

contributor for this issue among the products related with pig and its derivatives and others prohibited sources (Muhammad, 2011).

Production of authentic halal product is obligatory to Muslim whereby, pork is prohibited to consume. The non-halal product are not allowed to be consumed by Muslim due to the prohibited in Islam as well as contributed to the health and social problem. The Muslim's products should be free from anything unlawful like pig and its derivatives and be well prepared according to Islamic Law. Some others religions like Judaism, Jew and Hinduism also forbid their followers to consume any kind of the product which containing pork and its derivatives. Hence, porcine based in the food product, especially in pharmaceutical is a serious matter in the view of religious (Hanzaee and Ramzani, 2011).

Pharmaceutical is one of the product that has been used and become part of our necessity in daily life. The developments of halal sources in pharmaceutical are very hard to achieve, due to the high costing for the entire process in receiving halal certificate (Muhammad, 2011). Hence, most of the production sources in pharmaceutical industry come from pigs. Unfortunately Muslims, Jews and vegetarians have to be very particularly selective when buying the products. They must go through the ingredients list of the product before buying it.

The porcine based ingredients have been widely used in the pharmaceutical industry especially in capsule manufacturing. In this matter, there is high possibility that the capsule is made of porcine-based which is gelatine. Therefore, it is very crucial to choose a fine product with the full information given. There are various innovation ingredients in pharmaceutical industry especially in antibiotic drug development which made it become more complex and difficult to access the halal status of the product (Muhammad, 2011).

Nowadays, the matter of using porcine in pharmaceutical products is very critical. Every single part of pig was applied in pharmaceutical product without waste. As a Muslim, consuming pork and its derivatives is considered haram or prohibited. However, from an Islamic perspective, the usage of porcine in medicine is allowed if there is no other alternative or halal product of medicine that can be used for treatment of the disease. All the prohibition was applied in the situation in which the person has a choice (Al-Qaradawi, 1988). Allah S.W.T has said in the holy Qur'an.

“ He has explained to you what He has made haram for you, except that to which you are compelled.”

(Al-An'am, 6:119)

The emergence of using medicine from pig derivative is allowed as it is necessary for preserving life. However, taking medicine which contains some of the haram substance is permissible only under the following condition for instance, the life of patient is endangered if he does not consume the medicine, there is no other available alternative of medicine that has been made from a halal source entirely and the medication is only prescribed by a Muslim physician, whereby he has knowledge as well as God-fearing (*Taqwa*) (Al-Qaradawi, 1988).

However, there are many alternatives that can be used to replace porcine for medical treatment nowadays. Thus, it is an obligation for the Muslim to consume the halal source rather than haram. Presently, there are many tools of chemical methods that have been used to detect the presence of pork and its derivatives in the sample. The demand for a simple and rapid method of chemical analysis for the detection and quantification of pork in capsules is increasing due to the requirement of halal verification from pharmaceutical, religious compliance and health perspectives (Al-Qaradawi, 1988).

Besides, Malaysia desires to be the global for halal integrity as reference centre for the best practices in products, processes, standards and certification. As stated by the Third Industrial Master Plan, the Malaysian Government will be the centre for the production and distribution of halal products, halal service providers, reference on the halal standard and research and development for halal matter (Ismail and Ehsan, 2008).

Hence, in this study, the objectives of this research are to collect the information regarding the issue of halal and haram in pharmaceutical product and also to detect the porcine based as a source in pharmaceutical product. In recent year, there are growing concerns about the halal product as well as halal services. Malaysia desires to be the global for halal integrity which is as a value and benefits to consumers by the Muslim and non-Muslim. Malaysia has also developed for halal food industry in worldwide. It has many of opportunities and potential for offering the world halal products. The halal products offered the good quality, good health, hygienic, safety and efficacy product to be consuming by both Muslim consumer and also non-Muslim consumer.

Thus, it is very important for consumer to choose the halal product, especially food and pharmaceutical product. In advance of modern science and technology, there are many tools that have been developed to detect the presence of pork and its derivatives in the product. Fourier Transform Infrared (FTIR) spectroscopy with the combination of Attenuated Total Reflectance (ATR) is a one of the chemical method that has commonly used for the qualitative determination of the halal product. Therefore, the aim of this study is to detect porcine source in capsule for halal pharmaceutical authentication.

1.3 Statement of the Problem

Capsule is a stable shell used for medicines in pharmaceutical. It is the best alternative in pharmaceutical world due to the potential of the capsule which beneficially for consumer to avoid bitter in drug. Physically, it was soluble in water and there are two main types of capsule which are soft-shelled capsule and hard-shelled capsule. The soft-shelled capsule usually used for oil or liquid substance meanwhile, for hard-shelled capsule normally used for powder or dry substance. Both of these types of capsules are mainly made from animal protein which is gelatin. It was derived from various animals by-product like porcine (pig) and bovine (cow). Generally, gelatin was made from porcine. It is due to the low cost as well as easy available (Muhammad, 2011).

According to Baco (2010), there are many evidences about the usage of porcine in the pharmaceutical. For example, quoted from a newspaper Published Online on June 21 (2006), there was many of the pharmaceutical products contain an element of porcine in the sample. It was happened due to the, restricted alternative of verification for the medication or pharmaceutical product by the Department of Islamic Development Malaysia (JAKIM). At May 7 (2010), the national pharmaceutical control bureau (NPCB) has controlled the drug registration holders to withdraw the medicine from the market which contain porcine source.

According to Associated Proffesor Dr. Syed Azhar Syed Sulaiman, Dean of the School of Pharmaceutical Sciences USM, gelatin was produced by a mixture of protein which extracted from pig skin. He also claimed the porcine gelatin had been widely used because the cost is greatly lower compared to the other gelatin sources such as beef gelatin. Regarding this issue, Dr. Syed Azhar commented that, the Ministry of Health must take a serious action toward this matter. The usage of porcine in pharmaceutical cases also has been reported by a lot of consumer recently. Pharmacy of Universiti Sains Malaysia (USM) had found that, there are thirty

percent of the hundred healthcare products in Georgetown contained gelatin capsule from pig derivative.

Pharmaceutical product is one part of the necessity in our daily life. Nowadays, the matters of using porcine as a based source in pharmaceutical product become a very crucial and big issue for the consumer especially for the Muslim, Jewish and Hinduism. It is due to the forbidden of consuming pig and its derivatives by the view of religious. This matter has been clearly mentioned in the holy Qur'an.

“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.”

(Al-Baqarah, 2: 172)

Therefore, it is very important for the consumer, especially Muslim to choose the halal product. The government is also concerned about the issue of halal pharmaceutical because it affects the society in Malaysia. Besides, it is a big effort to achieve these goals since; the Malaysia Government has made Malaysia as one of the halal food global (Muhammad, 2011).

Nowadays, the halal product was broadly used in human lives today and become more comfortable by the Muslim day by day. Therefore, the ingredient of the product need to be inspected and tested to meet the halal requirement. Subsequently, some source of the ingredients are unable to be categorized as halal or haram. Hence, it will be categorized as shubhah or questionable (doubtful). This is due to the complex of source derivative. Thus, according to the Islamic Law, these ingredients should be avoided (Muhammad, 2011).

In order to develop a competitive halal product industry, the scientific processes are needed to monitor every aspect in production of the products including the health and religious compliance. Hence, the product will be free from unlawful source according Islamic Law. Using the application of science and technology in pharmaceutical, porcine based can be possibly detected in a source of pharmaceutical product. The patient might be obliged to consume a doubtful product in term of religion compliance in order to cure the disease or illness. However, this various kind of medicine can be actually segregated. Thus, the consumer can make a wise decision while consuming the medicine in the market.

By using chemical method, there are many types of the scientific method that has been used for the detection of porcine in the sample. For instance, High Performance Liquid Chromatographic, Polymerase Chain Reaction (PCR), ELISA, Chemometric., Electronic Nose, Mass Spectroscopy, Gas Chromatographic (GC) and Differential Scanning Calorimetry (DSC) (Hashim *et al.*, 2010). All these method has been performed to the sample for the detection of porcine in the sample such as the detection of lard adulteration in cake formulation, virgin coconut oil, cream cosmetic, vegetable oil, puff pastry and beef meatball (Hashim *et al.*, 2010).

However, the new method has been developed, which is by using the combination of Fourier Transform Infrared (FTIR) spectroscopy with the Attenuated Total Reflectance (ATR) and Discriminant Analysis (DA). The combination of FTIR-ATR was offered as non-destructive technique, easy to handled, less sample needed, high sensitivity, easy sample preparation and rapid detection technique for analysis. Meanwhile for the Discriminant Analysis DA), it was performed by using TQ Analyst software (Hashim *et al.*, 2010). It is important in order to create a model (Mahalanobis distance) which useful to detect and differentiate the difference source.

By the combination of Fourier Transform Infrared (FTIR) spectroscopy and Attenuated Total Reflection (FTIR-ATR) with the Discriminant Analysis (DA), we

can identify the halal or non-halal source in the sample by the simple preparation technique as well as fast detection analysis compared to others chemical analysis. Thus, this issues has been created awareness to the people about the importance of halal and how the issue of using porcine in pharmaceutical (capsule) have been solved by using the combination of FTIR-ATR and Discriminat Analysis (Hashim *et al.*, 2010).

1.4 Objectives of the Study

There are several goals to be achieved through this research.

- i. To investigate the issues of halal in pharmaceutical product.
- ii. To discover the porcine based source in the sample by the scientific by using combination Fourier Transform Infrared (FTIR) spectroscopy and Attenuated Total Reflectance (ATR).
- iii. To determine the sensitivity, level of awareness and the main effect of using porcine based in pharmaceutical product from the respondents among biology students.

1.5 Questions of the Study

In this study, there are several questions that have to be answered through this research study. The question of this research study as follows:

- i. What is the issue of halal in pharmaceutical product?

- ii. How Fourier Transform Infrared (FTIR) spectroscopy and Attenuated Total Reflectance (ATR) is able to detect porcine source in the sample?
- iii. What is the level sensitivity of respondents about the using porcine based in pharmaceutical product?
- iv. What is the level awareness of respondents about the using porcine based in pharmaceutical product?
- v. What is the the main effect from respondent's view about the using porcine based in pharmaceutical product?

1.6 Significance of the Study

The purpose of this research is to detect porcine based source in the pharmaceutical product. Hence, the finding of the research will help us to study the properties of porcine based source in pharmaceutical. This project was also acts as guidance and reference for future work on the best alternative that can replace porcine based sources in pharmaceutical and give awareness to the people about the importance of halal in daily product, especially in pharmaceutical.

Thus, the detection of porcine based source in pharmaceutical by using chemical analysis method is very important to improve product quality without a doubt in health and religious compliance. It will also helps for futher improvement towards compliance on halal standard among the pharmaceutical industry and also as a guidance for the consumer to define clearly halal products in medicine especially antibiotic drug. This purpose is to assure consumers for getting the halal and also be guarantee the *tayyiban* (clear) aspects of the quality, safety and realibility of the product.

This study will also help the Department of Islamic Development Malaysia (JAKIM) and other agency in monitoring the state of Islamic product. Furthermore, this study will provide exposure and awareness to the community with guidelines on halal food in Islamic line. This will be tally with the government's intention to make Malaysia the global halal food production center.

1.7 Definition of Terms

In this study, there were many terms of Arabic and Science that has been used. Description of each term is significant in order to clearly describe the situation of this research study. For the Islamic part, there are few words of Arabic that has been used. Meanwhile, for the research or scientific part, there are also few words of Science that has been used in this study.

1.7.1 Halal

According to Al-Qaradawi (1988), Halal means, is permitted, with respect to which no restriction exist and the doing of which the Law-Giver (Allah) has allowed. Halal is a term derived from the Quran which come from *halla*, *yahillu*, *hillan*, *wahalalan*. It is an Arabic word or Qur'anic term which means lawful, permissible, allowed or permitted by Islamic laws whereby, neither is nor consist or contains any part of prohibited animal by the Muslim accordance with Shari'ah Law. It refers to anything stuff that is permissible in Islam Law (Hanzaee and Ramzani, 2011).

Halal will be used to describe something like food, pharmaceutical, beverages, meat product, cosmetics as well as personal care product which are

allowed to be used for Muslim and it was decided based Holy Quran and the Glorious Shari'ah. Halal products are those that are free pork and other prohibited source which was not harmful, hygiene and safe to be consumed. Halal is important in a way of life and it not only labeled to the types of food, but also to the product like cosmetic, pharmaceutical, beverages, meats as well as clothes (Golnaz *et al.*, 2010). It was also provides a good, hygiene, clean and excellent product for healthy eating.

1.7.2 Porcine

Porcine is a scientific name for pork or pig. The term of porcine is widely used in medical for the statement of source of the pharmaceutical product. It is widely used as a source of gelatin for connective tissue. According to Gómez-Guilléni (2011), porcine is the main fibrous protein constituent in bones, cartilages and skins.

1.7.3 Fourier Transform Infrared (FTIR) Spectroscopy

According to Lampman *et al.* (1976), Fourier Transform Infrared (FTIR) spectroscopy is a mathematical operation which can be used to separate a single absorption frequencies from the interferogram and producing a spectrum virtually identical to that obtained with a dispersive spectrometer. Infrared spectroscopy is a type of optical spectroscopy that uses infrared energy which is particularly useful in organic chemistry for identifying the type of functional groups present in molecules. Meanwhile according to Rohman *et al.* (2011), Fourier Transform Infrared (FTIR) spectroscopy is a chemical analysis method that has been used for halal authentication or halal verification purpose by the detection of porcine based in the sample by using molecular vibration based on the reaction between infrared light and the bonding in the compound.

There are two methods that has been used with the combination of FTIR. Firtsly was by the combination of FTIR with ATR, Attenuated Total Reflectance. ATR is the method that has been widely applied as a practical and convenient method for the infrared analysis of liquids, semi-solids and solids.

1.7.4 Attenuated Total Reflectance (ATR)

According to Overbeke *et al.* (1995), Attenuated Total Reflectance (ATR) spectroscopy technique has been greatly used for the research study of films and the composition of polymer. It has also been applied in pharmaceutical factor, chemical industry and clinical chemistry for quantitatives analysis such as surface of fils and the composition of polymers (Overbeke *et al.*, 1995). FTIR is also has been used as the combination with KBr (Kalium Bromide). This method has been applied by using Kalium Bromide as a medium for making pellet of the sample.

1.8 Scope of the study

In this study, there is some research limitation that has been outlined by focusing on some specific scope. This study is carried out in a area of UTM Skudai, Johor. It is conducted to determine the level of awareness and knowledge among of biology students about halal pharmaceutical according to Islamic law. This study involves 91 respondents from biology students in UTM. They were chosen as respondents due to their knowledge about Islamic Law as well as understanding about the using scientific application of chemical analysis Fourier Transform Infrared Spectroscopy and Attenuated Total Reflectance (FTIR-ATR).

1.9 Summary

In this chapter, the research has been done according to the objective and the scope of the research study. The research limitation has been outlined by focusing on some specific scope like the total of the respondent, the place of field study and chemical analysis method, which is by using the combination of Fourier Transform Infrared (FTIR) spectroscopy and Attenuated Total Reflectance (ATR) with the Discriminant Analysis (DA). The issue of using porcine based in pharmaceutical product become a critical issue and lead to the statement of the problem in this research according to the paper reported. This study is important to find the best alternative for the detection of porcine based in the sample as well give awareness to the consumer about the importance of halal.

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