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ONTOLOGY-BASED TRACEABILITY SYSTEM FOR HALAL STATUS OF FLAVOUR: A CONCEPTUAL FRAMEWORK

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ABSTRACT

Recent market survey on halal products indicated an increase in the demand for halal products throughout the world. In Malaysia, JAKIM is the body responsible in matters relating to approve the halal certification. However, the process of issuing the halal certificate is time consuming. This study further identified the issues and contributing factors in the delay in approval for halal certification application by reviewing related works and conducted a preliminary interview with the JAKIM authorities. The reasons for the delay in issuing halal certification is the constraints in determining halal status of flavours due to the absence of halal certificate when auditors were processing the documentation for applying certification. In addition, the inconsistent use of terms among the food producers and the auditors makes it difficult to trace halal status of flavouring. However, these factors are isolated. None of the studies have clearly depicted the interrelationship among factors and constructs. This paper therefore aims to theoretically integrate the factors and constructs as a conceptual framework. The conceptual framework shows the relationship of the concepts: halal certification process, halal concept, as well as reference sources and the concept of traceability using an ontology-based semantic web technology approach to trace the halal status of ingredients, especially in the chemical properties section consisting of various reference sources. The conceptual framework could then be used as a basis to design a framework for tracing flavouring information to accelerate the halal certification.

Introduction

Countries whose official religion is Islam like Malaysia need suitable food that does not affect their faith such as food that is Halalan Thoyibba. The term Halalan Thoyibba means halal and good (Man & Yahya, 2014). The characteristics of Halalan Toyyiban refers to food items, especially raw materials, that are considered halal if for instance, animal that is recognized by syariah about its halal status such as chicken, cow and goat and that the animal is not a carcass (an animal that has not been slaughtered). Among other features is the way to kill the animal to be eaten is through method of slaughter recognized by the Sharia, which is to use a sharp slaughtering tool. For plants, the characteristic of halal is if the plant does not contain poison and is intoxicating. According to Mohani et al. (2013), food produced by a third party whose identity is not known, requires the assurance that the food is safe to be eaten by Muslims and complies with syarak, i.e. syarak texts such as the Qur'an, the sunnah of ijmak ulama, qiyas and other Islamic authoritative sources. The intended assurance is in the form of a sign of trust such as the Halal logo as shown in Figure 1.

Figure 1: Standard Halal Logo by JAKIM

Verification of a product is obtained through a process called halal certification (Baizuri et al., 2012; Abdul Aziz, & Chok ,2013). Halal certification activities generally consist of several stages, namely evaluation of application documents, field inspections, presentation of reports that will be evaluated by the Evaluation and Recommendation Committee and approval to approve halal certificates. In the process of giving a halal certificate, the Halalan Thoyibba concept is one of the elements that is emphasized from the beginning to the end in producing a food product. Therefore, the traceability process plays a role in obtaining a halal certificate as a medium that helps to determine whether a raw material or food product is halal or otherwise.

A study by Azram & Atan (2011) found that society are more careful about the ingredients in the food products they buy. This shows that there is an increase in awareness about the composition of food products. The identity of processed materials or composite mixtures is not always clearly stated, and confirmation is required that the components used are from sources that are safe for use by consumers (Lockley & Bardsley, 2000). For Muslims, the status of food products is important because they need to be careful about the halal status of a product (Anir et al., 2008). The demand for halal food makes traceability important for producers, manufacturers, and distributors to provide Shariah-compliant products and meet the health and safety requirements (Shafii & Wan, 2012). Therefore, there are previous studies that focus on traceability in a food product (Chifu et al., 2007; Skoglund & Dejmek, 2007; Wang et al., 2012 and Salampasis & Kalogianni, 2012) and traceability studies aimed at supporting food quality and safety (Pizzuti et al., 2014). In the process of providing halal certificate, the traceability stage for an ingredient is at the stage of document review to apply for a halal certificate. Each ingredient listed in the document applying for a halal certificate will be singly examined whether it has a halal certificate or not. Ingredients that do not have a halal certificate are categorized as critical ingredients. This critical ingredient mostly consists of the flavour category. Determining the halal status of critical ingredients requires product specifications and flow charts of critical ingredients.

The aim of this paper is to identify the current problem in tracing the halal status of flavours to approve an application for a halal certificate for a food product in Malaysia, to explore solutions to mitigate the issues and problem from prior research and preliminary interview with JAKIM auditors and to design a conceptual framework for traceability system for halal status of flavour to accelerate the halal certification. The structure of this paper is as follows: In Section 2 investigates the issues and problem

related to halal certification process. Section 3 reviewed the related work. Section 4 explains the proposed conceptual framework. Section 5 concludes the paper with a summary of the main findings related to halal certification.

Issues and Problem

In the food industry domain, the content of food needs to be taken into account to identify the food ingredients that are certified for their content and prove the status of the food product as halal (Jasic et al., 2007). This halal status is important so that consumers are not exposed to food that contains ingredients that are harmful to consumers (Raspor 2005). This halal status can be obtained from halal certification activities. Issues in the process of giving halal certificates arise when the process of approving halal certificates is found to take a long time (Shafie, & Othman, 2006). Shafii & Wan's study (2012) reported that the halal certificate approval process took 6 months. (Shafii & Wan, 2012). study examined the elements required in developing a framework to detect halal status to help manufacturers produce halal products. Among the elements involved are issues in halal detection, acceptance of halal detection, halal certificates, safe food, laws, document sustainability, competitive advantage, chain communication and downsizing the workforce. (Shafii & Wan, 2012). study found that traceability elements are important in producing halal food products. The results of the survey regarding the framework in traceability found that studies are more focused on the traceability framework that can help producers to produce good, quality and safe food (Regattieri et al., 2007; Salampasis & Kalogianni, 2012; Storøy et al., 2013). There is also a traceability framework that can assist manufacturers in producing halal products (Shafii & Wan, 2012). Until today, there is still no study regarding the framework for tracing the halal status of raw materials such as flavours that can help the authorities in processing applications for halal certification.

In addition to not having a specific traceability framework, previous research found that JAKIM's Halal Hub Division did not have a database or information system sufficient to process applications for halal certificates (Ahmad Hishamuddin 2007). JAKIM's Halal Hub Division only has an e-Halal system that provides an online application form for food producers applying for a halal certificate. A preliminary interview conducted in this study showed that JAKIM's Halal Hub Division does not yet have a system capable of tracing the halal status of an ingredient (raw material) used in producing food. At present, JAKIM's Halal Hub Division auditors is required to refer to several specific sources such as the Handbook of Fenorolli and some academic journals to detect the content of a flavor to determine whether it complies with Sharia or otherwise. However, the reference to some sources is still not sufficient because all the search information results acquired, need to be confirmed by flavour domain experts. The process of manually checking the halal status of a flavor shows that there is no integration between reference sources and expert knowledge. Another factor that contributes to the slow process in approving the halal certificates' application is the use of different terms between producers and JAKIM Halal Hub Division auditors in identifying the halal status of certain flavours. For example, the manufacturer lists one of its flavors called 'adelhyde ethyl ether' which has the same meaning as the term instead of 'ethyl vanillin' which is a term commonly used by JAKIM's Halal Hub Division auditors. The non-uniformity in the use of the flavor terms causes JAKIM's Halal Hub Division to face problems in checking the halal status of flavour. Therefore, a framework for tracing the halal status of flavours is needed to help speed up the process of granting halal certificates to food manufacturers.

To overcome the problem of the delay in tracing the halal status of ingredients, Omar et al. (2013) developed a system for verifying the halal status of ingredient, involving the development of E-Numbers ontology from various databases. Their study aimed to help the Muslim community to verify the halal status of a product in the market that contains E-Numbers. This study used the ontology that is the backbone of the semantic web to connect various databases from the website about E-Numbers. In developing the ontology in E-Numbers there are several existing chemical domain ontologies that can be used namely Chemical Entities of Biological Interest (ChEBI) and PubChem Bioassay Database (PubChem). Ontology elements are used in the E-Numbers ontology development study because the role of ontology is to integrate heterogeneous databases while providing a consistent vocabulary (Jagadish,

1990). However, Jagadish's (1990) study only helps the Muslim community to confirm the halal status of a product that is already on the market. JAKIM's Halal Hub Division auditors need to trace the halal status of flavours which is not only based on E-numbers. There is no study that develops ontology to help the JAKIM authorities in confirming the halal status of certain flavours.. Based on the role of ontology in Omar et al. (2013) study, ontology can be applied as a process in designing a framework for tracing the halal status of flavours to solve the problems faced by JAKIM's Halal Hub Division. The ontology of flavours is important to develop in solving the diversity of sources referred to and the problem of non-uniformity in the use of flavour terms between the producers and the JAKIM Halal Hub Division.

The main objective of this study is to design a framework for tracing the halal status of flavours to support halal certification. Specifically we analyzed and identified the tracing process and information sources involved in tracing the halal status of flavours in approving halal certificates for food products. Next we designed the framework of Flavour Halal Status Tracing System to develop and implement a flavour ontology that can link several sources of flavour information into a form of flavour information representation. The framework will then be validated for tracing the halal status of flavours through the use of the Flavor Halal Status Tracing System.

Related Work

Past studies that examined halal certification focus on the issues and challenges in halal certification (Shafie & Othman, 2006), and on the perception of food, pharmaceutical and medicine manufacturers and restaurant operators on the quality of JAKIM's service in processing applications for halal certification (Badruldin et al., 2012; Mohani Abdul et al,. 2013; Syed Marzuki et al., 2012). Among the applicants' perceptions is that the quality of service from JAKIM does not meet the expectations of halal certificate applicants, such as delay in processing applications to obtain halal certificates, preoccupation of officials with site management and monitoring tasks and not having its own laboratory to carry out tests to determine the halal status of a raw material (Badruldin et al,. 2012). However, there is still no study that overcomes the problem for the delay in processing applications for halal certification.

In Malaysia, official bodies such as JAKIM are responsible for encouraging food producers to apply for halal certification and ensure that their clients successfully obtain halal certification. According to Baizuri et al., (2012) the halal certificate issued by JAKIM is recognized worldwide (TradeMart 2005; Muhammad et al. 2009) based on its strict criteria and has a strong relationship with the world's main trade in addition to solid support from the government (Abdul Aziz, & Chok, 2013). Halal certificate application in Malaysia is through the e-Halal system (https://apps.halal.gov.my/apps/e-halal.php?new=). Applicants are required to register in the e-Halal system first. After that the applicant can fill in the application form and send the form online in the e-Halal system. Once the application is sent, JAKIM starts processing the application form. Several researches address the importance of traceability which is a sub-process to halal certification.

Traceability involves input from various fields such as recording and monitoring of all operations in the field, chemicals, physical and microbiological analysis of the entire production chain, genetic fingerprinting (labelling), marketing studies and data processing for tracking input in a manageable, transparent, and meaningful form (Sarig 2013). For processed foods, effective traceability means that the recipe, ingredients, and method of processing the food as well as the location of the processed food are accurately recorded. Traceability in food products is needed because the demand for safe food products from end consumers is increasing (Regattieri, et al., 2007). Sarig's (2013) study found that the only mandatory traceability system currently is the food chain system for beef sold within the European Union. The system is capable to trace back the origin of the beef. At present there is no traceability study that helps the authorities in granting halal certificates to food producers.

Studies on traceability frameworks focused on Food Supply Chains. Among them are red wine (Bechini et al., 2005), cheese (Regattieri et al., 2007), meat (Mukviboonchai et al., 2008) and so on. All previous studies on traceability frameworks are more focused on use for food producers. Food producers need a traceability framework as their guide in tracing the flow of food products produced by them (Bechini et

al., 2005; Regattieri et al., 2007; Salampasis, & Kalogiann,i 2012). Regattieri et al., (2007) study posits a traceability framework is needed to clarify legal and regulatory aspects of food traceability as well as developing a framework for traceability systems.

Shafii & Wan, (2012) emphasizes the halal aspect in the study, which is to develop a traceability framework to detect the halal status to help manufacturers in the production of halal products. There are 9 elements in the traceability framework proposed by (Shafii & Wan, 2012). Among them are issues in halal detection, acceptance of halal traceability, halal certificate, safe food, law, document sustainability, competitive advantage, chain communication and reducing the workforce. Elements of issues in traceability can be used in studying the reason why the halal certificate approval process is slow. The halal traceability acceptance elements can be used to study the traceability of ingredients that are important to produce quality and safe food products while maintaining the reputation of food product manufacturers. Halal certificate elements can be used for halal status required for every ingredient used in the production of food products.

Traceability studies also explored different traceability methods. Skoglund & Dejmek (2007) used the fuzzy traceability method to improve production quality in liquid foods, namely dairy products. This fuzzy traceability method uses a dynamic model for configuration and simulation of real conditions in the production of dairy products. This method aims to review each stage in the production of dairy products according to their respective groups (batch). However, this method is more suitable for producers to detect if there are any problems with the dairy products produced by them. Apart from the fuzzy traceability method, there are several previous studies such as Chifu et al. (2007), Wang et al. (2012) Salampasis & Kalogianni (2012) and Pizzuti et al. (2014) who used ontology methods in their respective traceability studies.

The first traceability method that has been identified is based on the paperwork used to record information about incoming and outgoing products, while the latest traceability method is based on the use of information technology. According to the Food Standard Agency (2002) in the United Kingdom, traceability based on information technology is more effective than traceability based on paperwork. According to Magliulo et al. (2013), the use of information technology in traceability can support recording and storage of data and can share traceability attributes such as processing, genetics, input and detecting diseases/insects. There are recent studies conducted on how ontology can be used to establish a semantic model of traceability by reusing information sources in the detection process to gain accuracy and efficiency in information management. Furthermore, the information shared in the food supply chain system is varied and it is collected into different data collections. Therefore, the function of ontology in traceability is to integrate heterogeneous databases and enable interoperability between different systems because a consistent vocabulary is required to obtain clear information and unification of information from various sources (Jagadish, 1990).

There are several studies that apply ontology in food tracking, especially agricultural products. Chifu et al. (2007) who used ontology in meat traceability proposed an ontology model to facilitate automatic annotation and composition on Web services. This ontology model contains core ontology and 2 taxonomies namely Business Service Description and Business Product Description. The proposed ontology model is used in the ontology development for traceability for the food industry domain. Certain concepts of the domain ontology in this study are organized into a taxonomy that is automatically built from text descriptions from the website of meat industry companies. Wang et al. (2012) developed an ontology-based detection system for fruits and vegetables. The purpose of this system is to improve the quality and safety of fruits and vegetables. Wang et al. (2012) concentrated on the agricultural chain and defined a semantic model for the detection of fruits and vegetables by dividing this domain into a set of sub-systems consisting of the cultivation system, procurement system, transport system and sales system.

Salampasis & Kalogianni (2012) applied ontology in his study to produce efficient traceability in the Food Supply Chain System for the seafood domain. The ontology development in the Salampasis & Kalogianni

(2012) study is based on a framework called TraceALL, which is a framework for tracking applications based on the semantic web (Berners-Lee et al. 2001). The semantic web is an extension of the World Wide Web (WWW) where semantic forms and services on the web are defined. Data and information in the semantic web is not only human readable but it can be shared between machines. The TraceALL framework is needed because TraceALL considers traceability for food products to be a complex integration and there are problems in business processes that require information sharing. The TraceALL framework is largely driven by the needs of the various parties involved in the Food Supply Chain to be able to contribute and use traceability data effectively. The TraceALL framework is needed because different business processes in the Food Supply Chain require interoperability between systems and sharing of information.

A study by Pizzuti et al. (2014) involved the development of a food ontology used to trace the flow in producing food products. This food ontology named Food Track & Trace Ontology (FTTO) is part of a general framework dedicated to managing food tracking and it has been developed with the aim of being connected to the Global Track & Trace Information System. FTTO can be defined as a semantic detection model. The development of FTTO reuses some of the information sources used in the tracking work process. The use of FTTO can contribute to the accuracy, reliability, and efficiency of the information management system. FTTO was developed because there was a need to enable information sharing throughout the food supply chain. Food traceability can be seen as part of a complex system where different business processes work together in sharing information about the product and the parties involved. To enable the sharing of information, the relevant data must be coordinated.. However, FTTO was found to focus on tracking within the internal Food Supply Chain System where the system only involved food producers. The study by Omar et al. (2013) also developed food ontology. The intended ontology is the ingredient ontology, specifically E-numbers. The development of the E-numbers ontology involves various E-numbers databases. The E-numbers ontology aims to help users verify the halal status of a food product. This shows that ingredients also affect the halal status of a food produced.

Various types of ingredients can be found on the label of the purchased product. Some of them are simple or single components such as salt, sugar, and water. However, there are also complex or compound components such as dyes, cheese powder, seasonings, flavors, fats, spices, and the like. On some product labels, ingredients are listed according to functions such as antioxidants, emulsifiers, preservatives, additional flavours, and thickeners (Quadri et al. 2013). Sometimes ingredients such as alcohol, enzymes, fat and gelatin whose halal status is an issue are not clearly listed but they are hidden in flavourings, cheese and ice cream. These ingredients consist of several types such as ingredients obtained from animals or plants, microbes, and synthetic sources. Ingredients can be classified in the halal category if they meet the following conditions (IFANCA 2013):

i. Ingredients produced from animals; the animals must undergo a slaughter process according to sharia.
ii. Ingredients consisting of alcohol must be less than 0.5%, products produced from alcohol must have less than 0.1% alcohol.

In food processing, food manufacturers cannot avoid using additives in food, most of which are imported and made from various sources, whether animal or plant (Muhamad et al. 2005). Food manufacturers need to be alert to ingredients commonly used to process food such as food additives, amino acids, animal fats and proteins, dyes, sauces and seasonings, emulsifiers, enzymes, fats and oils, fat and grease-based coatings, flavours and flavourings, gelatin, glycerin, hydrolyzed protein, meat and meat-based products, packaging materials, stabilizers, thickening agents, vitamins, and whey protein. To process halal products, all contamination related to non-halal ingredients must be avoided. The demand for halal food products prompted (Shafii & Wan, 2012). to develop a halal traceability framework that assists food manufacturers in producing their halal food products. In a study by Azram, & Atan (2011) the method of tracking software engineering development flow is implemented on documents that contain information on bread production. Their study found the method implemented is suitable for tracing the ingredients used in a food product.

The above reviews indicate that previous studies attempted to identify the issues and contributing factors in the delay in approval for halal certification application. However these factors are isolated. None of the studies have clearly depicted the interrelationship among factors and constructs. This paper therefore aims to theoretically integrate the factors and constructs as a conceptual framework. The conceptual framework could then be used as a basis to design a framework for tracing flavouring information to accelerate the halal certification.

Conceptual Framework

This paper addresses the following questions:

i. What are the processes and sources of information involved in tracking the halal status of flavour in halal certificates for food products?
ii. What are the elements required in the design of the framework to detect the halal status of flavour?

To answer the research question, we employed content analysis to study the issues found in processing halal certificate applications as well as the steps involved in halal certification application based on literature review and preliminary interview results with auditors at JAKIM's Halal Hub Division. The result of the content analysis is concepts related to halal certification process; steps involved in the procedure for approving a halal certificate. The concepts and their relations are conceptualized as a framework as shown in Figure 2:

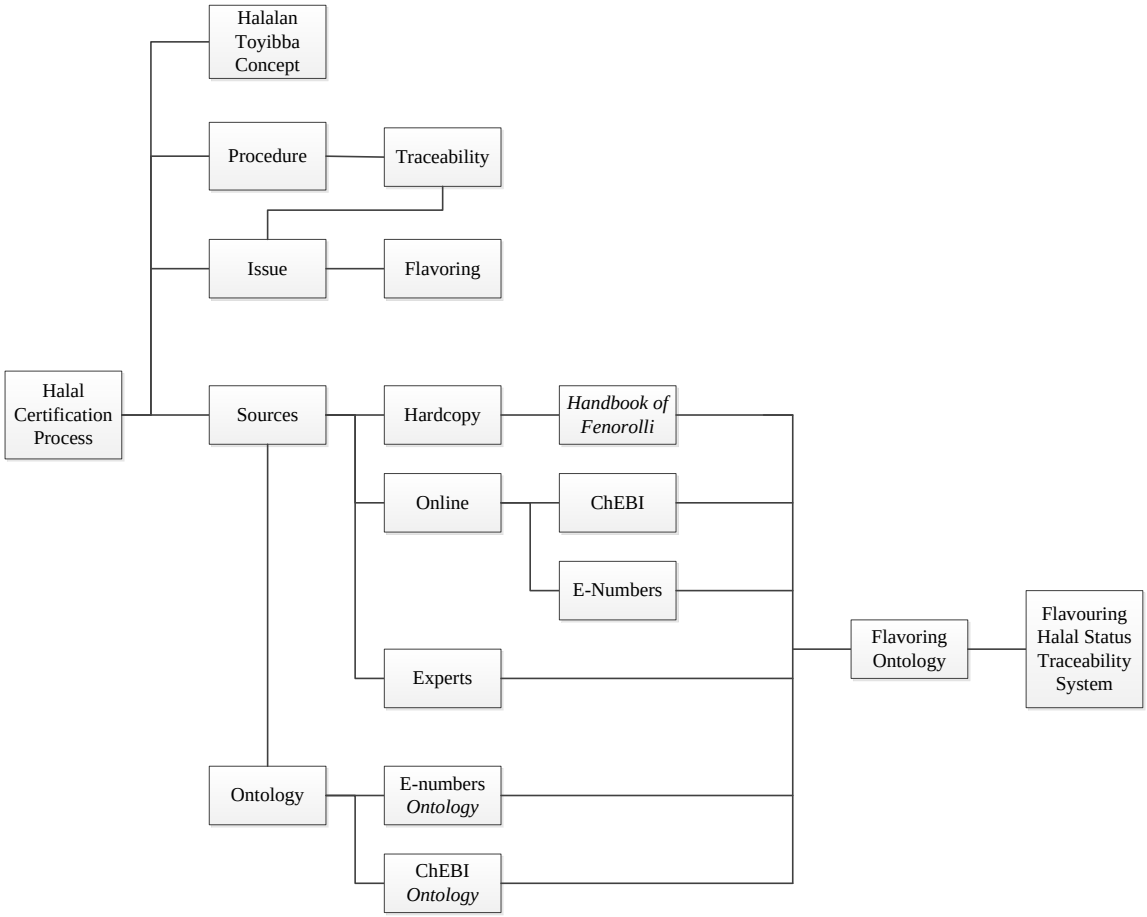

Figure 2: Conceptual Framework

The conceptual framework of this study focuses on the halal certification process in Malaysia. Among the concepts studied in the halal certification process is the Halalan Toyibba concept, the overall halal certification procedure as well as the issues found in the halal certification process. Toyibba's Halal concept is studied to enable researchers to understand the halal concept in detail. The halal certification procedure was studied to find out every step involved in the procedure of approving a halal certificate. Based on the results of the study on halal certification procedures, there are issues that contribute to the slowness of approving halal certificates, especially for certain food products. The issue in the delay for approving the halal certificate of a food product is due to the content of the food which mostly consisting of flavours, many of which belong to the category of critical ingredients. Critical ingredients are ingredients that do not have a halal certificate. The auditors at JAKIM's Halal Hub Division need to ensure the halal status of every flavour used in the production of a food product. Among other reasons that cause delays in approving halal certificates is that the process of tracing the halal status of a flavour that takes a long time because the auditors at JAKIM's Halal Hub Division is required to refer to various printed sources such as the Handbook of Fenorolli and online sources such as academic journals. However, this reference sources still needs confirmation from an expert in the flavour domain.

This study also examines the concept of ontology based on the ability of ontology to combine various types of resources into one form of information representation. Based on review prior studies, there is a study that developed an E-numbers ontology that involves several types of information sources regarding E-numbers, one of which is the ChEBI Ontology. The use of reference sources such as Handbook of Fenorolli and ChEBI Ontology will be integrated with expert knowledge to develop flavour ontology for this study. Flavour ontology is then implemented into the Flavour Halal Status Traceability System. The following paragraphs will discuss some of the concepts studied.

Halalan Toyibba

The term 'Halal' found in the Al-Quran which means permitted (Hussaini 1993; Mohamad 2005; Tieman 2011). According to the Encyclopedia of Islamic Law, halal is defined as liberating, releasing, breaking, dissolving, and enabling. In Malaysia, the term 'Halal' is found in the Trade Description Act 1975 which refers to food. According to Omar & Jaafar (2011), the term 'Halal Borne' or 'Halal Borne Food' indicates that a Muslim is allowed to eat products that are permitted by Shariah. The Trade Description Act 1975 defines the words 'Halal', 'Muslim food' or 'Halal borne' food. The term 'Halal' in the context of this study refers to the resources (raw materials) used in the production of flavouring ingredients which (Interview JAKIM 2014):

i. Does not contain or consist of any parts or things from animals that Muslims are forbidden by Islamic law.
ii. Does not contain animals that can be eaten but are not slaughtered in accordance with Shariah law and fatwa.
iii. Does not contain any impure things according to Islamic law and fatwa.
iv. Do not intoxicate according to the law of Sharia and fatwa.
v. Does not contain any parts or human parts or products from them that are not allowed by Shariah law and fatwa.
vi. Non-toxic or harmful to health,
vii. Not prepared, processed or in a factory using any equipment that is contaminated with faeces according to Shariah law and fatwa.
viii. Not in the time of preparation, processing or storing it in contact with, mixed with or close to any prohibited food.

Halal Certification Process

Halal certification means inspection of the food manufacturing process (preparation, slaughter, ingredients used, cleanliness, processing, and storage) including transportation and distribution (Baizuri et al. 2012). Halal certification can be defined as an official award from an official body on the process of preparing, slaughtering, cleaning, handling, and management (Abdul Aziz & Chok 2013). According

to Abdul Aziz & Chok (2013), this halal certification is not limited to animal husbandry only but also includes consumer goods such as cosmetics, pharmaceuticals, and personal grooming equipment. Halal certification in the context of this study is an examination of the composition of the raw materials, the flow chart of producing the raw materials and any processing equipment involved in producing flavours. This inspection is involved in the review stage of the halal certification application documentation sent by the supplier for the purpose of obtaining a halal certificate.

Traceability

Webster's Dictionary (2004) defined traceability as the ability to follow or study in detail, step by step, the history of a particular activity or process. ISO 1995 defines traceability as the ability to obtain information such as the history, application, or location of an entity or the identification records of an entity. According to Gellyneck & Verbeke (2001), the tracking system provides data related to place and time regarding the location of a food, food ingredients and the food production chain. Meuwissen et al. (2003) defined tracking as the ability to track or check the flow of products starting from product production up to the level of product distribution into the industry. Traceability in the context of this study is defined as the step in tracing the composition of raw materials, the production flow chart of the raw materials and any processing equipment involved in producing flavour.

Ingredients

Ingredients can be defined as materials needed to make something such as wood for the house, leaves and roots for medicine and others (DBP 2010). The definition of ingredients according to the Oxford Fajar Advanced Learner's English-Malay Dictionary (2001) is any food or ingredients that are combined to make a certain dish. Ingredients in the context of this study are raw materials needed in the production of flavours.

Flavours

Flavour means something added to food or drink to give it a certain taste (Cambridge Dictionary 2014). According to the European Food Safety Authority (2014), flavours are ingredients used to give taste or smell to food. Flavour is also defined as a substance used to give a specific taste to food (Collins Dictionary 2014). Flavours are part of the ingredients that are mostly used to produce food (Quadri et al. 2013). Flavouring in the context of this study is an additive to food that needs to be determined for its halal status.

Ontology

The term 'Ontology' was initially popular in philosophical circles meaning existence. By the year 2000, the term ontology was applied by the Knowledge Engineering research community. Among the earliest definitions of this ontology was given by Neches et al. (1991), who defined ontology as "basic terms and relationships to define connections to vocabulary". Based on these terms, ontology does not only contain clearly stated terms, but the knowledge that can be inferred from them. A few years later, Gruber (1993) also defines ontology as "a real representation of a domain". Based on Gruber's definition, many definitions of ontology have been published and proposed by the ontology community. Borst (1997) slightly changed the definition of ontology given by Gruber which is: "ontology as a formal representation that is shared about a certain domain". The term ‘formal’ refers to the fact that the ontology is machine-readable and ‘shared’ reflects the idea that an ontology takes consensual knowledge, that is not private to some individuals but accepted by a group. While the definition of ontology according to the context of Liang et al. (2006) is a system of terms, definitions of terms and specification of relationships between terms. The term ontology in the context of traceability is a standard that can combine some information about ingredients from various sources (Pizzuti et al. 2014).

The conceptual framework offers a theoretical understanding on how the above concepts are interrelated. This conceptual framework provides a guide to solve the constraints that arise in determining the halal status of ingredients that do not have a halal certificate when processing the documentation of halal certification applications. Constraints that arise are in terms of the use of raw material terms that are stated by food producers different from the authorities in halal certification. In addition, the variety of reference sources referred to by the authorities in halal certification also slows down the process of determining the halal status of ingredients. Therefore, a standard is needed to standardize the use of raw material terms so that communication between food producers and authorities in halal certification runs smoothly. A medium is also needed to combine all reference sources referred by the authority in halal certification into a database. This makes it easier for the authorities in halal certification to refer to the necessary reference sources in determining the halal status of flavours that do not have a halal certificate. The intended standard and medium is ontology because ontology can standardize the use of certain terms and can unify information from various sources into a database.

Conclusion

This paper discussed the halal concept that can guarantee quality and safety which is important in food production. The high demand for halal products from Muslim countries as well as non-Muslim countries shows that people are more concerned about their nutrition. As a result, the halal industry has grown rapidly. In Malaysia, the process of approving the halal certificate implemented by JAKIM takes a long time. This study discovered several factors affecting the delay in approving a halal certificate for a product much of which relates to problem in the review stage of the halal certification application documentation and constraints in determining the halal status of a flavour. The delay is due to insufficient database or absence in information system to process applications for halal certificates. To mitigate these issues and factors, studies extended to examining traceability in terms of tracing types, practices, systems, frameworks, methods and so on. Recent traceability practices and systems are more focused on tracing in the food supply chain system. Until today there is still no study on the traceability system that can help the authorities in granting halal certificates to food producers.

This study is important to be carried out to solve the constraints that arise in determining the halal status of ingredients that do not have a halal certificate when processing the documentation of halal certification applications. Having identified the issues and contributing factors in the delay in approval for halal certification application and discovered related areas such as traceability and ontology that prior studies had explored, this paper had theoretically integrated the factors and constructs as a conceptual framework. The conceptual framework concentrates on determining the source of raw materials and its' halal status, traceability and ontological development involving the integration of references related to flavouring in the application of semantic web. The conceptual framework could then be used as a basis to design a framework for tracing flavour information to accelerate the halal certification process.

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