Study on the Requirement of Clay for Islamic Cleansing in *Halal* Food Industry

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Abstract: Islam is "*Ad-din*" or a way of life. It covers all aspects of human activities including matters related to food and drinks. For Muslims, food must not only nutritious and safe but must also be *halal*. *Halal* is an Arabic word from the Quran which means permissible or lawful. *Halal* food products can become non-halal (haram) if they are contaminated or have direct contact with *najis al-mughallazah* (extreme *najis*). According to Islamic law, *najis al-mughallazah* is an extreme najis derived from dogs and pigs, including any liquid or discharge from their orifices, descendants and derivatives. In cleansing of extreme *najis,* Islam required the use of Islamic cleansing method called *samak (*in Malay*)* or *dibagh (*in Arabic*)*. Thus, in compliance with the *halal* food industry requirement, three (3) clay soil samples and 1 standard were chosen to determine the clay requirements for Islamic cleansing. The basic physico-chemical properties of clays such as pH, particle size distribution (PSD) and moisture content were determined. In addition, the mineralogical content and safety aspects of the clay such as toxic metals and total bacteria content were included. The study on clay requirements for Islamic cleansing is important criteria for its usage in the *halal* food supply chain as it will enhance the consumers' confidence and integrity in halal products.

Keywords: halalan toyibbanl, Islamic cleansing, clay, food, safety

Introduction

The market for halal industry has increased from USD580 billion in 2008 to USD2.3 trillion in 2012 (Hooi, 2012). This significant increase is due to global demand for halal products and services which give consumers more variety to guide them in their choices. Meanwhile, globally there are about 1.8 billion Muslims spread out in 100 countries, which required them to consume and use halal products (anonymous, 2012). As a result, halal certification is increasing in demand worldwide. Halal Certification is recognition that the products are permissible under Islamic law. These products are thus edible, drinkable or usable by Muslims.

Islam is "*Ad-din*" or a way of life. It covers all aspects of human activities including matters related to food and drinks. For Muslims, food must not only nutritious and safe but must also be *halal*. *Halal* is an Arabic word from the Quran which means permissible or lawful, meanwhile haram is anything that is prohibited or unlawful (Al-Qaradawi, 2001). It refers to things or actions permitted by *Shariah* law (Islamic law) without punishment imposed on the doer. It is usually used to describe something that a Muslim is permitted to engage in, e.g. eat, drink or use. Beside halal, the word toyyib is always used together with halal which means it shall meet the quality, safety (not hamful) and wholesomeness (Che man et al., 2005). This statement is clearly stated in the Holy Quran: Surah Al Mā-idah 5:88, which means *Allah* commands Muslims and all mankind to eat and live on *halal* and *toyyib* products (Din-Al-Hafiz, 2008). In addition, halal is not only cover religious aspects but it complies strictly to quality and hygiene in the production of foods, drinks, pharmaceutical, cosmetics, personal care products and other consumer products. *Halal* food products can become non-halal (haram) if they are contaminated or have direct contact with *najis al-mughallazah*. According to Islamic law, *najis al-mughallazah* is an extreme najis derived from dogs and pigs, including any liquid or discharge from their orifices, descendants and derivatives (SM, 2009). To comply with the halal requirement, plant processing food, pharmaceutical and cosmetic products shall be dedicated to halal production only. Meanwhile, converting production lines, equipment or apparatus containing najis al-mughallazah into halal production line requires the procedure of Islamic cleansing, which is called samak or sertu in Malay or *dibagh* in Arabic. In general, cleaning process using detergent and water does not fulfilling the requirement of Islamic law in the cleansing of extreme najis. In halal perspective, the use of clay to clean extreme najis from dogs and pigs has been the practice in Islam. In order to comply with halal requirements, Islam requires proper cleaning through seven steps of washings, whereby the first step of washing must be water mixed with soil or clay, followed by the subsequent 6 steps of washings with clean water (SM, 2009; Ab-Rahman & Masran, 2008).

In the traditional practice of Islamic cleansing in one's ordinary life, there is no restriction on the amount of clay or soil used and no specific requirements needed as long as one follows the Islamic requirement. Likewise, cleansing extreme najis for industrial application requires some modifications from this traditional practice. Since, the halal compliance covers from raw material production and delivery to consumer, there shall be no contamination from najis during preparation, manufacturing, processing, storage or distribution (SM, 2009). Therefore, if they are contaminated with extreme najis, the equipment, devices and apparatus used in the processing lines, packaging, labeling, handling, storage, transportation and distribution as well as the contaminated area need to be cleaned by Islamic cleansing process. As some of this equipment is expensive, delicate, sophisticated and may be precise, the modification of clay or soil for Islamic cleansing is required and important not to cause any damage and scratch on the specific equipment. As such, a specific clay standard with certain requirements for halal industrial application is needed as well as meeting the equipment or machines specifications.

Materials and Method

Three clay soil samples and standard clay were chosen for the Islamic cleansing study (Table 1). The clays were oven dried, cooled and kept in clean container. The pH of clay was determined using a ratio of 1 clay to 2.5 deionized water (Rayment and Higginson, 1992). The moisture content of clay samples was analyzed using gravimetric method (Walter, 1986), whereas the particle size distribution (PSD) and texture analysis were identified using sedimentation pipette method (Gee and Bauder, 1986; Day, 1965). Toxic metals (lead, arsenic, mercury) content was detected by inductively couple plasma-mass spectrophotometry (ICP-MS) technique (Falciani *et al*., 2000). The total microbial content of clay samples were determined by the total plate count (TPC) method (Cappuccino and Sherman, 2005).

Table 1. Source and code of clay samples

Clay Samples	Source	Code of Sample
Bercham	Perak, Malaysia	A
Sayong	Perak, Malaysia	B
Kaolinite	Commercial, USA	C
Standard	Commercial, Malaysia	D

Results

The pH values of clay samples were in the range of 5.01-6.71 (Table 2). Clay D (standard) exhibited the neutral condition (pH 6.71), whereas, clay A, B and C were slightly in the acidic group. The PSD study showed that clay C possessed the highest clay content (89.00%) as compared to clay A (42.31%), B (53.95%) and D (36.00%). The particle size of clay is < 2 µm, silt and sand are 2-20 µm and >20 µm, respectively. The texture class of clays was determined by USDA textural triangle (Figure 1). All the clay samples were in dry condition as their moisture contents were in the range of (1.79-3.45%), whereby, clay D gave the lowest water content (1.79%). Toxic metals such as arsenic (As), antimony (Sb), cadmium (Cd) and lead (Pb) were determined for safety assessment. The results of clay samples (Table 3) were compared with the Malaysian Food Regulation 1985 which stated the maximum permitted level of metal contaminants for As (0.7 ppm), Sb (0.7 ppm), Cd (0.7 ppm) and Pb (7 ppm). All of the clay samples did not exceed the levels specified in the Malaysian Food Regulation 1985. As shown in Table 4, clay C had the lowest microbial load ($<1.0x10^{1}$ cfu g^{-1}). The highest microbial load was found in clay A from Bercham, Perak ($<2.0x10^{6}$ cfu g^{-1}). However, most of the clay samples in this study except clay A had lower microbial count compared to the legal limit set by DKS 129:2009 and Turkish Food codex.

Table 2. Physico-chemical properties of clays

Clay Sample	PSD*		Soil Texture	Moisture	pH
	Clay (<2 µm)	S (2-2			
A	42.31	29			5.28
B	53.95	45			5.01
C	89.00	10			5.28
D	36.00	54			6.71

*PSD=Particle size distribution

Figure 1. USDA textural triangle (Image source: www.soilsensor.com)

Table 3. Toxic metal content in clay samples and limit permitted by Malaysian Food Regulation (1985)

	Toxic metal (ppm)			
	As*	**Sb***	**Cd***	**Pb***
Malaysian Food Regulation 1985	0.7	0.7	0.7	7.0
Clay Sample				
A	0.02	0.01	0.02	0.11
B	0.06	0.01	0.02	0.36
C	ND	0.01	0.01	0.03

D	0.02	0.01	0.02	0.31

*As=Arsenic, *Sb=Antimony, *Cd=Cadmium, Pb=Lead, **ND=not detected

Table 4. Total microbial load of clay

	Microbial load (cfu g^{-1})
Kenya Standard (DKS 169:2009)	< $1.0x10^5$
Turkish Food Codex	< $1.0x10^5$
Clay Samples	
A	<$2.0x10^6$
B	<$2.0x10^3$
C	<$1.0x10^1$
D	<$8.0x10^3$

Discussion

Since clay is used to clean severe najis from dogs and pigs in Islamic cleansing, it is important to check the pH of the clay. All of the clay samples were in a slightly acidic to neutral range (pH 5.01–6.71). As compared to most of commercial detergent products, their pH values are above 8.5, which is in the alkaline range (Patterson, 2009). The pH value is a very important criterion in cleaning process because the high alkaline pH water may harm the environment and natural surface when it is being discharged. Furthermore, pH plays a part in rust development in the machinery or equipment. Corrosion can occur even at the minimum level at pH range of 6-12, and rust can develop outside this range (Llewellyn & Hudd, 1998). Under very acidic or alkaline conditions rust would develop rapidly because of the reduction of hydrogen ions, even though not all metals have the same level of corrosion resistance (David, 2005). Hence, the pH of clay samples determined in this study are important and appropriate in conserving the natural environmental when they used clay as a cleansing material for *halal* compliance in the industries. In addition, clay is better than the regular detergents as it has a safe pH range.

From the PSD results, all of the clays have fine particle sizes (Table 2). The textures of the clays are mostly clay. The best clay in this study is sample C (kaolinite), which contained 89.00% clay and 10.00% silt. The smaller particle size of clay contributes to the large surface area of the clay and this would increase the ability of clay to absorb and carry impurities (Parolo *et al*., 2010). In addition, clay has unique characteristic that can be used as an ingredient in developing products for cleaning. For example, in cleaning products, clay has been used as an additive to increase viscosity in order to control the flow of a product on the target surface, as well as adding shine on products. In cleaning process, the small particle size of clay facilitates the sample to pass through the manufacturing equipment and processing lines, hence reduce the possibility of the surfaces of the equipment from being damaged, scratched, and clogged. All the clay samples in this study can be used for Islamic cleansing products.

To date, there is no standard or guideline established for Islamic cleansing clay. According to Patterson (2009), the standard moisture content for most of the powder detergents is in the range of 1.4-28.7%. Therefore, the standard moisture content of detergent powder is used in the development of clay for Islamic cleansing requirements. The study demonstrated that all the clays are in dried condition, range of moisture between 1.79-3.51%, therefore, they are stable during storage and able to prevent microbial growth.

All of the clay samples had lower toxic metals (As, Sn, Cd, Pb) content and met the allowable limit specified in the Malaysian Food Regulation 1985 (MOH, 2011). This Regulation ensures products are safe for consumers. Toxic metals are dangerous because they form bioaccumulation in the body (Collins & Stotzky, 1991). Bioaccumulation is defined as an increase in chemical's concentration in a biological organism over time compared to the chemical's concentration in the environment. These compounds are accumulated in living things when they are consumed and stored faster than they are metabolized or excreted. Toxic metals cannot be degraded or destroyed. As such, the toxic metal contaminants in the clay used for Islamic cleansing should be identified to ensure it is safe for use.

Another criterion of safety is the microbial load in the sample. Microbial load were determined to ensure the clay for Islamic cleansing are safe to use for halal food industries. This study can minimize the probability of product contamination by microorganism which can be either from raw materials or during manufacturing, processing, damaged of the container or during application of Islamic cleansing process. The safety aspects also fulfill the halal and thoyyib requirement under Islamic law (Hashim *et al*., 2009). To date, there is no standard or guideline of total microbial load for Islamic cleansing clay. As such, the limit in wheat flour and flour products are the closest to compare and bear in mind the wheat flour is used for cooking. The allowable limit of microbes in wheat flour specified by Draft of Kenya Standard and Turkish Codex is $<10^5$ cfu g^{-1} (DKS, 2009; Aydin et al., 2009). However, the study showed that the microbial load of the clay samples (except clay A) after heat treatment at 160ºC was lower than the standards allowable limits (Table 4). The commercial practice use 2% clay for Islamic cleansing, followed by 6 times of washing with water, normally warm or hot water is used. Since the contamination from microbes is low, the clay samples are safe to use.

Conclusions

The pH, PSD, moisture, microbial load and toxic metal contaminants are important requirements for the clay used for Islamic cleansing of extreme najis in halal food industries. All clay samples including the standard clay (clay D) in the study met the required criteria. The development of clay requirements for Islamic cleansing can significantly contribute to the overall growth of the *halal* industry and enhance the level of confidence of the consumers in *halal* products. In addition, this product can be conveniently and economically produced.

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