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Good agricultural practices and its compatibility with Halal standards

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ABSTRACT

Background: Food from agriculture is fundamental to our survival and play a very important role in our daily life. It acts as a source of energy and provides us with essential nutrients. The consumers' attitudes towards food and agriculture are changing based on regional, cultural and religious influences. Food production following Halal principles is emerging as one of the most important challenges and holds a leading position in the global business today.

Scope and approach: Halal's main objective is to ensure that the process and ingredients are entirely clean, pure and comply with Islamic principles. A transparent system of Halal auditing has been developed to ensure a manufactured product that complies with all Halal requirements. To harmonize and facilitate the process of Halal certification, a compatible system between Halal standard and agricultural good practice or other recognized safety standards, need to be established.

Key findings and conclusion: The future demand for Halal products is high and has a strong presence in developed and developing countries. To harmonize Halal system with others, all issues related to Halal production of food and agriculture are presented. Highly critical topics such as manure, pesticides, lubricant, and genetically modified product have been highlighted and their Halal status with regards to their nature, process, and composition have been discussed. Furthermore, Halal compatibility with good agricultural practices has been determined.

1. Introduction

The human is driven by two vital forces, namely organic needs and instincts. Food is classified as an organic need and fundamental to human survival. Humans are innovative by nature and determined to develop tools, technologies and design concepts to preserve and enrich civilization. Food is one of the three pillars of civilization (Brown, 2009); thus, many efforts have been invested to increase the quantity and improve the quality of food to cope with the increasing population (Perez-Escamilla, 2017). Most of the ingredients we eat are mainly derived from animal and vegetarian sources. To follow customer needs and trends, new ingredients need to be added or removed to comply with certain health issues. Industries are aiming to produce profitable, and irresistible products, whereas consumers are aiming to make their own food-buying choices, rather than having those choices made for them. Food safety is one of the core issues in food production (Burks, Sampson, Plaut, Lack, & Akdis, 2018) if misused, it will have a serious impact on health and environment.

Good agricultural practices (GAP) are a set of principles, that must

be applied to agricultural production and post-production to ensure safe and healthy food, while taking into account economic, social and environmental sustainability (Da Cruz, Cenci, & Maia, 2006). The soil should contain appropriate amounts of nutrients, and essential building blocks to ensure optimal plant growth and quality. Approved chemical fertilizer and composted animal manure are often used to promote plant growth (Pérez-Montaño et al., 2014). The packed dried crop is stored in a dry, well-ventilated building with minimal variation in diurnal temperature. Equipment used for the production and handling of crops is lubricated, cleaned, sterilized and dried by air to ensure safe and clean production.

The halal term is frequently used in the Muslim and non-Muslim world; however, Halal is regarded as a concept for Muslim, an idea for non-Muslim and an issue for certifying bodies. The halal concept means permissible, and covers all aspect of human behavior, include eating, wearing, seeing and talking. Interestingly, whenever the concept of Halal is presented in the context of food, the concept Tayyib is explicitly coupled, therefore it is necessary to use the combined term Halal-Tayyib when Halal food is presented. The Halal concept is followed by

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almost 1.5 billion people worldwide and pay attention to what they eat and drink in their daily life. The Halal standard for food and pharma is described and rational application of the concept and its implementation in industries is well documented (Ratanamaneichat & Rakkarn, 2013). Many companies have used the system in their production and Halal Assurance is carefully implemented.

The main principles of good Halal practices (GHP) are ingredients, process, and location. In general, from the Halal perspective, ingredients are being classified into three categories: highly critical, critical and non-critical. Criticality is determined by the source, nature and the process being used during the production. In general, highly critical is potentially non-Halal until proven otherwise. A critical ingredient needs further evaluation “Mashbooh”, whereas non-critical is Halal. Ingredients, process and location are strongly correlated with the Halal and Tayyib systems, which are the basic principles for understanding and producing Halal foods.

2. Important aspects of food production under Halal standard

2.1. Tayyib

Tayyib is an Islamic expression which represents a process, location, contamination, and other safety related issues. The concept of Tayyib has been strongly conjugated with the Halal concept when food and its related elements are cited. The objectives of Tayyib is to achieve maximum hygiene (clean) and minimum contamination (pure), whereas the main goal of Halal-Tayyib food is to create calmness and comfortable feeling when food is taken. The comfortable feeling cannot simply be achieved by having healthy and safe food, which is essential, however pleasant and comfortable feeling is achievable if what we eat is compatible with what we believe. Comfort food that is selected and influenced by what we believe is known to improve our mood, make us feel better and give us a sense of well-being (Alzeer, Rieder, & Abou Hadeed, 2017).

Many of the food additives and ingredients as well as fruits, vegetables, and meat are Halal, as a subject, however the methods, location, and processes used to transform raw ingredients into food or to transform food into other forms are often non-Tayyib. Integrating Halal and Tayyib concepts is essential and a prerequisite in Halal food production. If the process is not clean, and has potential cross contamination or contains toxic ingredients, the end products cannot be Halal certified, even though basic ingredients as a subject is Halal, thus for e.g. crops irrigated with sewage water cannot be Halal certified.

Food may act as a potential vehicle for disease transmission. Indeed, Islam emphasized strongly on the issue of food safety and contamination, and implementation of Tayyib concept (clean and pure), as a public health priority, is essential for the protection of human health and improvement of life quality. Any food contaminated with pathogenic microbes or with potentially toxic ingredients that may pose a risk to human health is considered non-Tayyib, ultimately non-Halal and cannot be used for eating purposes (Kurniadi & Frediansyah, 2017).

2.2. Ethanol

Ethanol is an important organic solvent and substrate which is extensively used in food, pharmaceutical, cosmetic and many other industrial applications. Many ingredients are suspended in ethanol solutions. The Halal status of ethanol is highly controversial, and many Muslim scholars consider ethanol as non-Halal, regardless how it's prepared. More rational studies revealed the Halalness of ethanol, which is dependent on the source and concentration (Alzeer & Abou Hadeed, 2016). According to these studies, any ethanol produced by anaerobic fermentation in the range of 1–15% is considered non-Halal, whereas ethanol produced by natural fermentation and less than 1% is considered as preserving agent and its Halal status is allowed. Any ethanolic solution higher than 15% is considered as a toxic. On the

other hand, the toxic ethanol solution can be prepared and stored for disinfection and other industrial applications. An ethanolic solution prepared by dilution from absolute or denatured ethanol is allowed for industrial use but toxic for human consumption. However, any concentration from 0.1 to 100% prepared with the intention to be used as a beverage is considered non-Halal. As ethanol always has the potential to be used in alcoholic drinks, Halal certificate for ethanol cannot be issued, although ethanol as organic solvent or disinfectant is allowed to be used from Halal perspective.

2.3. Manure and fertilizer

Manure refers to the natural substance that is obtained from the decomposition of the waste of plants and animals. It is rich in organic material but contains little amount of plant nutrients. Manure enhances the capacity to retain water, improves the texture of the soil, increases the number of friendly microbes and facilitates the exchange of gases. On the other hand, fertilizer is the chemical substance that contains a lot of plant nutrients that are necessary for the growth and production of the plants (Choi, Kwak, Lim, Park, Chang, Lee et al., 2017). The type and quantity of fertilizer is selected according to the needs of various plants for their growth and development. From an Islamic perspective, chemical fertilizers that have been approved by the countries of cultivation and consumption are allowed to be used. It is Halal to use farm manure which has been thoroughly composted to meet safe sanitary standards of acceptable microbial limits. It is prohibited (non-Halal) to use urban household garbage, industrial and hospital wastes or human feces as fertilizer. Untreated raw manure is considered to be non-Halal as it has the potential to contain foodborne pathogens that may cause human disease. Raw manure derived from an animal is considered Najis (Li, Guo, Dong, Anhring, & Zhang, 2016), but after treatment, macromolecules such as oligosaccharides, polypeptides, and lignins will be converted or decomposed into micromolecules, mainly carbon dioxide, methane, nitrogen gas, ammonia, hydrogen sulfide, phosphate, and other building blocks (Ezzariai, Hafidi, Khadra, Aemig, El Fels, Barret et al., 2018). As the structure of the macromolecules has been changed into new micromolecules with new physical and chemical properties, the concept of Istihala (change in the state) is valid and the end product of the treated manure is considered Halal (Mohd Kashin, Alias, Zin, Said, Zakaria, Salleh et al., 2018).

2.4. Genetically modified products

A genetically modified organism (GMO) is an organism whose genetic material has been altered using genetic engineering techniques (Davison & Ammann, 2017). These techniques, generally known as recombinant DNA technologies, use DNA molecules from different sources to create a new set of genes. Genetically modified crops are plants produced through GMO techniques and used in agriculture. The main objective of GM crops is to introduce a new trait to the plant other than that found in the nature of the species. The new traits will improve resistance to certain pests, diseases, environmental conditions, and chemical treatments (Kamthan, Chaudhuri, Kamthan, & Datta, 2016). Debate over safety, health, and ethical issues is the main concern (Kramkowska, Grzelak, & Czyzewska, 2013; Tsatsakis, Nawaz, Tutelyan, Golokhvast, Kalantizi, Chung et al., 2017; Domingo Roig & Gomez Arnaiz, 2000). In general, from an Islamic perspective, all products that have the potential to harm human's health, whether described in the Quran and Hadeeth or not, are considered Khabith and non-Halal. From a Halal point of view, the transfer of genetic material from plant-to-plant is classified as a highly critical process (Khattak, Mir, Anwar, Wahedi, Abbas, Khattak et al., 2011). However, it will only be accepted if it is clearly beneficial, the safety issue with regard to health has been resolved and the absorption, distribution, and metabolism of a genetically modified product are identical to those of its natural counterpart (Bawa & Anilakumar, 2013). If genetic material has

been transferred between two different kingdoms, e.g. animal-to-plant, the product is considered highly critical. Obviously, if genetic material was transferred from a non-Halal animal, the Halal status is non-Halal. Integration of DNA sequence, derived from the non-Halal animal, into food creates an uncomfortable feeling for the consumer. Such feeling is incompatible with the main goal of the Tayyib concept, thus, the compatibility system between what we eat and what we believe is not established in the body (Alzeer, 2018). The rejection mechanism dominates and causes stress for various biological processes throughout the body. If genetic material was transferred from Halal animal, the Halal status is still highly critical and potentially non-Halal. Insertion of the DNA fragment is designed to be beneficial to gene expression, but random integration or insertion of more than one copy of the DNA fragment into the target genome is possible and may have a potential adverse effect on gene expression. (Zhang, Wohlhueter, & Zhang, 2016). Additionally, if the transfer is done between two different kingdoms, the law of compatibility, and the matching aspect will remain an issue (Alzeer, 2019). A high probability of ‘accidental changes’ in genetically modified plants, will remain a long-term safety issue, and unexpectedly high doses of plant toxins could have a negative effect on human and the environment (Se-Hyeok, 2017; Baig, Saleem, Khan, Nadeem, Ahmed, Shahid et al., 2018). Furthermore, insects are remarkably adaptable and are increasingly developing resistance to genetically modified crops (Karthikeyan, Valarmathi, Nandini, & Nandhakumar, 2012). More scientific effort and studies are needed to ensure that the consumption of GM food is not likely to provoke toxicity, allergenicity, and genetic hazards (de Santis and Stockhofe, 2018; Dunn, Vicini, Glenn, Fleischer, & Greenhawt, 2017). The impacts of GM crops and adaptable insects on the environment need to be evaluated (de Vos & Swanenburg, 2018; Delaney, 2015). If those important aspects are not clearly and rationally resolved, the status of GMO will remain highly critical and non-Halal (Aslan & Aslan, 2016).

2.5. Animal ingredients

Many processed foods contain ingredients derived from animals that are forbidden by several religions and lifestyles. Main sources of non-Halal ingredients are derived from pork, birds of prey, scavengers, animals not slaughtered properly and blood (Farouk, Pufpaff, & Amir, 2016). In general, Muslims, do not eat animals classified as a carnivore (consume only meat), and omnivore (consume both meat and plant). Dead animals and birds with claws or birds that feed by snatching and tearing are also prohibited. Hence, animal ingredients used in Halal food production are generally derived from herbivore, that are anatomically and physiologically adapted to eat plants such as leaves and fruits. Additionally, Halal animals should be healthy and raised in a clean environment, fed with a diet free from animal ingredients.

2.6. Pesticides

Pesticides are chemicals used to eliminate or control pests such as insects, rodents, fungi that can damage crops or affect farm productivity. The need for pesticides is increasing and the areas of their use are expanding. Pesticides are composed of many chemicals such as arsenic, mercury, lead, chlorine, fluorine, phosphate, sulfur, and DDT (Martín, Revilla, Salcedo, & Quintana, 2018). All pesticides are toxic and potentially hazardous to humans, animals, and the environment (Sabarwal, Kumar, & Singh, 2018). Pesticides should be treated as toxic material; protective clothing must be worn when used and should be chosen with extreme care (Dugger-Webster and LePrevost 2018). A wrong dose or choice may damage the plant and affects the environment. From the Islamic perspective, killing insects or other living entities are forbidden unless there is clear harm for crops and human life. Thus, the Halal status of pesticides is Halal as long as the right dose and choice are used. Pesticides that cause a substantial damage to the crops, environment or human life, are non-Halal as described by the Prophet

Hadeeth “Do not cause harm or return harm. Whoever harms others, then Allah will harm him. Whoever is harsh with others, then Allah will be harsh with him” (At-Tirmidhi & No, 1940).

2.7. Lubricant

A lubricant is a substance, usually organic, introduced to reduce friction between surfaces in mutual contact, which ultimately reduces the heat generation as the surfaces move. Lubricants are often used for many purposes in food production, mainly to increase the lifespan of the machine and make it more efficient. Lubricants are classified into three categories: mineral, natural and synthetic. The Halal status of lubricants depends on the source and the process involved in the production. In case of mineral lubricants, which are predominately petroleum-based (Zainal, Zulkifli, Gulzar, & Masjuki, 2018) and are the most common lubricants; the Halal status is allowed. Natural lubricants are derived from either plant-based oils or animal-based fats (Syahir, Zulkifli, Masjuki, Kalam, Alabdulkarem, Gulzar et al., 2017). The Halal status of plant-based lubricant is allowed whereas the animal-based fats or tallow are highly critical depending on the animal source. Synthetic lubricants (Chang, Yunus, Rashid, Choong, Awang, Biak, Syam, 2015) such as hydrogenated polyolefins, esters, silicones, fluorocarbons, and many others are considered Halal. The Halalness of lubricants can be concluded if the production process is compatible with the Tayyib principles and classified as H1 food-grade lubricant.

2.8. Water

Agriculture requires large quantities of water for irrigation (Markland, Ingram, Kniel, & Sharma, 2017). Crops have very specific water requirements for optimal production (Estrada-Acosta, Jimenez, Chaidez, Leon-Felix, & Castro-Del Campo, 2014). Water is just one route by which foods can be contaminated with disease-causing agents or toxic chemicals, thus, the water source is potentially very important (Andrade, O'Dwyer, O'Neill, & Hynds, 2018). Contamination can arise in raw water or as a consequence of improper storage or pick-up of contaminants from distribution systems. Identifying water sources used for irrigation is essential. Sewage waters may contain various potentially toxic elements and organic matter with highly harmful effects on human and animal health (Saha, Panwar, Srivastava, Biswas, Kundu, Rao, 2010). In general, water is Halal, particularly, if it is coming from the following sources: rains, sea, river, wells, springs, snow and cold waters (melted ice). However, water mixed or contaminated with non-Halal sources such as toxic substances, alcohol, blood, and urine can neither be used for irrigation nor for the production chain. The same applies to changes in color, taste, and smell.

3. Discussion

Good agricultural practices (GAP) and good Halal practices (GHS) are systems intended to ensure the safety and compatibility of agriculture and food processing with Islamic principles. GAP is a series of principles that need to be fulfilled to ensure that agricultural products meet legal prerequisites for safety and quality. Processes, ingredients and their sources must be traceable, clearly defined and controlled, and instructions must be written in a clear language. The worker must be trained to carry out documented procedures at the production sites. Storages must be clean and prepared with minimized risk of cross-contamination.

GHS applies to any system involved in the production of the food chain, cosmetics, and pharmaceutical industry. The Halal standard is strongly conjugated with the Tayyib concept, where process and ingredients are well controlled, described and documented. The location of the site used for Halal production, need to be segregated from non-Halal site to prevent any potential cross-contamination with highly critical products. Primary packaging is critical particularly when

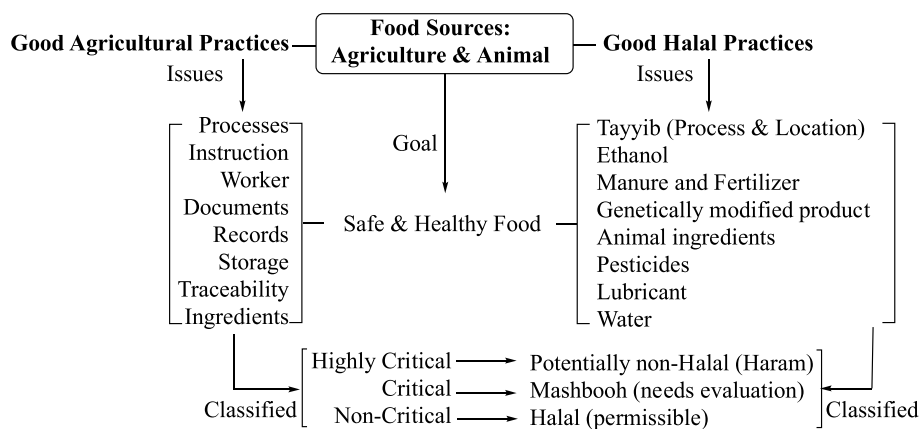


Fig. 1. Issues related to GAP & GHP.

coloured sacs, drums or alumina foil packaging are used. The main objectives of the Halal-Tayyib standard are to minimize contamination and maximize hygiene while complying with Islamic principles (Kohilavani, Zzaman, Abdullah, & Tajul, 2015).

Generally, GHP and GAP are compatible with each other. Islamic expressions such as Haram, Mashbooh and Halal, can be replaced by scientific expressions; highly critical, critical and non-critical, respectively (Fig. 1). The criticality can be endorsed by traceability where enrichment of documentation is essential. Highly critical ingredients that contain either alcohol or derive from animal, can only be endorsed by Halal certificate. Critical ingredients that are either extracted from natural products, or prepared in a chemical laboratory, can be endorsed by either Halal certificate or questionnaire. Non-critical ingredients, naturally and non-processed ingredients, are endorsed either by Halal certificate or questionnaire or statement. The degree of documentation and traceability can be intensified by using ingredients with valid Halal certificates.

A safety plan in the form of a GAP or another recognized form will be a prerequisite for obtaining a Halal certificate. Halal consumers and Muslim authorities started to realize the value and importance of Halal food requirements, thus, new regulations have been imposed to ensure the Halalness of the imported products. Halal and Tayyib concepts have become an established tool for improving safety and the implementation of Halal standard in the early stages of production is a growing trend (Abdullah & Dahlan, 2015). This can be seen via the adoption of Halal certificates in Europe, Asia, Australia, Africa, and America. GAP can be one of the components of Halal standard, that is designed to meet Halal demand throughout the world. Halal training and awareness of terms such as Halal, Tayyib, Najis, and Khabith would facilitate Halal certification and increase the potential of the product to comply with the Halal standard.

In general, company's vision is to enlarge the market and globalize their products, consequently the lifestyle of other nations needs to be considered and their products need to be produced according to the cultural background of various nations. Concepts like vegetarian, vegan, kosher and Halal are growing markets. The global Halal market has a value above 4.5 trillion USD and the trend is growing (Johnson, 2018). Halal certification will create a win-win situation for producers and customers. The producer will add value to the product and make it more competitive, whereas, for customers, the Halal certificate will add additional quality control, build trust with the producer, enrich cultural diversity and enhance building bridges between nations.

4. Conclusion

Good agricultural practice has been used as a general principle to produce safe and healthy food derived from agriculture. Halal is a growing brand and good Halal practice is slowly improving and

potentially could be used as a general principle to produce Halal products. We have briefly summarized the values of GAP and GHP and presented the important aspects associated with Halal productions. Both standards have many common principles, and could be enriched to facilitate Halal production. High critical issues such as GMO, animal ingredients and alcohol need to be carefully regulated for the good Halal production. Most of GHP principles are compatible with GAP principles, thus GAP or any other recognized and accredited form will be a prerequisite for obtaining a Halal certificate.

Vocabulary

Halal, Non-Halal, Tayyib, Najis, Khabith, Mashbooh, Istihala, Quran, Hadeeth, Haram.

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