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Halal Fermented Functional Food in Indonesia: A Review

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Abstract

Nowadays, people prefer to consume foods with better nutrition to enjoy life more healthily. However, Muslims must also eat halal food following the Islamic way of life; eating nutritious food alone is insufficient. Indonesia, the largest Muslim population in the world, presents a market potential for halal food manufacturers and consumers worldwide. Several varieties of regional fermented foods were listed on the halal-positive food list and free from the requirement of halal certification, as per Indonesian Halal rules. The review of Indonesian fermented foods listed in the category of positive halal foods is the main topic of this essay. The procedures used to review the chosen themes include finding the literature in online sources, screening for topic inclusion, and evaluating, extracting, and discussing the accessible data found in the publications. The potential functional local fermented food varieties are included on the positive halal list: T*ape* (sticky rice and cassava), *Dadih,* and *Tempeh*. These fermented foods' microbiological and chemical characteristics were discussed. Therefore, the functional value of these fermented foods is rich in phytochemicals, anti-cancer (*β-glucan*), antioxidant compounds (isoflavones) and probiotic components (lactic acid bacteria and yeasts).

1. Introduction

Consumption of halal food in Indonesia has begun to experience a significant increase, in line with the global demand for halal products, which has reached USD 1.8 trillion to 2.1 trillion (GIFR, 2015). The global growth of the Muslim population and increased understanding of halal are two essential factors behind changing consumption patterns among generations of Muslims (Ahmad *et al.*, 2015). In Indonesia, the Government has begun to pay attention to halal consumption patterns, along with the passing of the Halal Product Guarantee Law No. 33 of 2014, which became the initial foundation for changing the halal system in Indonesia. Before this, only a small portion of Indonesia's entire food industry used halal food processing, and halal certification was registered as voluntary. The whole food business is now required to have halal certification due to the passage of the Halal Product Guarantee Law No. 33 of 2014. This law represents a state's responsibility to provide protection and a sense of security in consuming and using products that comply with Islamic law.

Additionally, evolving patterns of dietary needs are encouraged by shifts in the community's worldview regarding the value of health and healthy living (Khoerunisa, 2020). In today's world, functional food is often defined as providing the body with comprehensive nutrition and certain physiological benefits (Amaliah *et al.*, 2019). Health costs, which tend to increase in Indonesia, are one of the drivers of the increasing need for functional food because it is hoped that this type of food can be a solution to minimise disease with essential components (Abbas, 2020). For Muslims, eating functional food is also necessary, but their religious beliefs require halal food. Foods without any non-halal ingredients are necessary for Muslim consumers. However, several compounds frequently used in food production today can originate from non-permissible substances. Using fermentation techniques to create these components offers a substantial advantage in avoiding confusion if the microbial production is carried out in line with halal regulations. Furthermore, the demand for halal microbial products has expanded, giving producers an edge in market rivalry. This is due to the interest in halal-certified food components.

Local food processing in Indonesia also uses conventional biotechnology and fermentation methods (Susanti *et al.*, 2019). Various microorganisms were used in fermentation (Griana & Kinasih, 2020). Several types of fermented local food that are known in Indonesia include fermented milk-based food (Soenarno *et al.*, 2013) tubers based (Utami & Djaafar, 2014), fruit and vegetable-based (Febricia *et al.*, 2020), meat and fish-based (Antika, 2019; Patel & Shah, 2017). However, Muslims cannot immediately consume food derived from fermented products because microorganisms are a critical point of haram in processing (Komisi Majelis Ulama Indonesia, 2010). According to Qaradawi (1994) , Islamic law prohibits the use of substances scientifically shown to be harmful to human health at any step of the fermentation process and stipulates that halal necessitates that human health protection always comes first.

In Indonesia, materials that are exempt from the requirement to obtain halal certification include 1) materials originating from nature in the form of plants or mining materials without going through any processing; 2) materials that are categorised as not at risk of containing proscribed substances; 3)

substances that are not deemed hazardous and do not mix with prohibited substances, according to the Decree of the Minister of Religion of the Republic of Indonesia No. 1360 of 2021 regarding the list of foods that are exempt from this requirement. In addition, the Decree listed several foods originating from local Indonesian fermentations, including *Tape* (sticky rice/cassava), *Dadih,* and *Tempeh*. Indonesia is inhabited by more than 300 ethnic groups, affected by the diversity of traditional fermented foods that reflect the importance of culture in each area, involving microbes of Indonesian biodiversities. The food products such as sticky rice/cassava) *Dadih,* and *Tempeh* is Indonesian indigenous fermented food that has formed an integral part of the diet and can be prepared using relatively simple techniques and equipment (Surono, 2016). This study aims to review the potential of fermented foods with clear halal status as functional foods so that they are safe and permissible for consumption by Muslims. Therefore, the results of this study are expected to shed light on alternative functional foods with clear halal status.

2. Materials and methods

2.1 Research methods

2.1.1 Journal reviews

Analysis was carried out on several articles related to functional food and local fermented food. Reputable search engines and databases such as Science Direct, Scopus, and Google Scholar are used to assist the research process. The following terms were searched: critical halal point, microbial, alcohol, and food industry; apart from that, scans were also carried out to search for articles, including research reports, journal articles, textbooks, and publications from both the Government and the private sector with years of publication between 2005 – 2022. The year 2005 was selected due to the year of forming the Indonesian Halal Product Guarantees Law began.

2.1.2 Data collection and analysis

This research used a literature review. This method was used to review the selected paper from online sources, including Science Direct and Google Scholar, screening for topic inclusion, assessing, extracting, and discussing fermented food based on local food with functional potential. Descriptive methods from several perspectives with elaboration were used in this analysis.

3. Results and discussion

3.1 Halal perspective of fermented food products

The fermentation process is a complex process that involves various components and changes in compounds (Ye *et al.*, 2019). The fermentation process is one way to improve the quality of food ingredients by adding microbes. Adding these microbes can produce taste, aroma, and colour in food (Kusuma *et al.*, 2020). Halal market trade is still very open, reinforced by the Asian market share, which is still the most significant global market (60%) (Alexander, 2018). Many fermented dairy products have been traditionally produced worldwide, generally dominated by fermented milk-based products, such as yoghurt and cheese (Bintsis & Papademas, 2022). These kinds of food products are susceptible to contamination by haram items because of the intricate nature of the fermentation process. The support materials utilised for immobilisation and other methods used in the fermentation process must be halal-approved. However, if the microbial generation complies with halal requirements, modern fermentation technologies significantly minimise interpretation (Yap & Al-Mutairi, 2023).

Fermentation processes are composed of two steps, preparations before fermentation and treatments after fermentation. While doing these steps, some principles should be considered, as the goal is to produce halal products. Based on Kurniadi & Frediansyah (2017) and Karahalil (2020), six main critical points are determining halal perceptions of fermentation-based products 1) microbial source, 2) microbial isolates, 3) growth media, 4) metabolic products, 5) production site (fermentation media), and 6) others added ingredients for a specific purpose. From this explanation, the microbial source in question is the origin of the microbe isolated or taken. Sources of microbes used in the fermentation process can come from various places, such as fruit, milk, and water (Gulitz *et al.*, 2011; Rahmah, 2021; Sujaya *et al.*, 2004; Sukmarini *et al.*, 2014) but can also be taken from animal body parts or animal waste (Azizah *et al.*, 2012; Purba *et al.*, 2022). Fermentations with microbes from animal body parts or isolated from the non-halal source are nonpermissive (Nuraida, 2015). Employing microbial obtained from a halal and hygienic environment in fermentations is also a critical prerequisite to reach the halal product. For example, it has been reported that some lactic acid bacteria strains were isolated from human faeces and meat, and their functionality was investigated using them for fermented products containing various vegetables (Nuraida, 2015). In the food industry, microbes and genetic modification used in the production process must be non-toxic and are only derived from halal-based sources (Estiati & Herman, 2016). Genetic modification of microbes also needs to be evaluated. At the same time, the gene source, the status of the final product and the potential effect on human health is generally discussed to be evaluated from a halal perspective (Karahalil, 2020).

Besides microbial origin, microbial growth media is also at risk of non-permissible contamination. Some microbial growth media were not approved as growth media because they have the potential for non-permissible contamination, including blood-based media (Djannatun *et al.*, 2008; Nurhidayanti, 2019), brain heart infusion whose components come from animal tissue (Liofilchem, 2017) and peptone media obtained from sources of non-permissible contamination. The termed inoculation, which is the addition of the microorganism to the fermentation medium, is another necessary procedure to start a fermentation process, such as tween 80, which needs to be checked carefully.

In addition to growth media, the fermentation media also should be halal-approved. Fermentation media is a controlled environment in which microbial productions are carried out that contain two major groups of nutrients. The major nutrients added to the medium are nitrogen and carbon sources. Their origin must be known because nitrogen and carbon can be obtained from animal sources (Lopes *et al.*, 2018). Nitrogen sources should not be derived from animals that are not halal, non-halal slaughtered and blood. They cannot be used if the aim is to produce halal bioproducts. In recent years, low-cost materials have been used with the potential to enrich the fermentation medium to minimise the fermentation cost. This media enrichment substrate, which has high nitrogen and carbon content, should be derived from a permissible source (Sulaiman *et al.*, 2014).

The results of metabolic processes during fermentation are also critical in determining the halal status of fermented products. One of the metabolic products that need attention is related to the amount of ethanol. Based on *Qur'an*, as Islamic Law, alcohol has been identified as a non-halal (haram, forbidden) substrate, and halal-certified products are usually alcohol-free (Alzeer & Abou Hadeed, 2016). In Indonesia, based on MUI FATWA No. 10 of 2018, it is explained that alcoholic drinks are considered *khamr* when the ethanol content is more than 0.5%. The law on products containing ethanol exceeding the limit set by the MUI, whether a lot or a little, is haram. Both food and drink containing *khamr* are considered haram (Halalmui.org, 2021). High amounts of ethanol in food products due to fermentation can cause these products to become non-halal. Ethanol is said to cause sodium disturbances in the human brain's synapses. There is also a link between alcohol and plasma membrane disturbances (Kurniadi & Frediansyah, 2017). Another process in fermentation where there is potential for permissible contamination is in the production process; one example is the production of yeast produced by beer companies (MUI FATWA No. 4 of 2003).

In addition, other auxiliary materials added for specific purposes in the fermentation process must also be considered. Auxiliary materials that are often used in the fermentation process include the use of skim milk (Juniawati, Sri Usmiati, 2013), alginate coating (Purukan *et al.*, 2020) and the use of whey protein (Tratnik *et al.*, 2006). The auxiliary materials were added to fermentation processes for various functionalities, such as improving the sensory and quality (Alonso, 2016). The food industry develops flavour innovation to reach consumers who enjoy the sensory experience of eating (Bublitz *et al.*, 2013). All auxiliary materials need to be halal-approved to have a final halal product.

Decree of the Minister of Religion of the Republic of Indonesia no 1360 of 2021 regarding the List of Materials Exempted from Obligation for Halal Certification (Positif List) mentions several types of naturally fermented food, such as *Tape* (cassava/glutinous rice)*, Dadih* and *Tempeh*. Based on these regulations, it can be assumed that the naturally fermented products mentioned above are categorised as having no risk of containing prohibited materials and are not classified as dangerous and not in contact with illicit substances. Natural ethanol produced by natural fermentation under aerobic conditions is halal by nature (Alzeer & Abou Hadeed, 2016). Therefore, KMA no 1360 of Decree of the Minister of Religion of the Republic of Indonesia no 1360 of 2021 guarantees that the Indonesian Muslim community can consume naturally fermented food without worrying about halal status. This is undoubtedly a positive value because the obligation to consume halal food is fulfilled. Another benefit that can be obtained from naturally fermented food is the health potential of the food mentioned above, which will indirectly improve the quality of life of Muslim communities and society in general (Suter, 2013). Fermented products included in the positive list are one of the reasons that the ingredients come from nature without processing and without adding other ingredients, including non-permissible materials and additives. This study will discuss the potential of sticky rice *Tape,* cassava, *Dadih,* and *Tempeh* as a halal functional food. The fermented foods from plants are well-developed in Southeast Asia and common in Indonesia (Law *et al.*, 2011). The fermentation process in various solid products can cause changes in taste and simplify complex compounds into simpler ones to be utilised optimally by the human body. Muslims rationalised the benefit concerning halal. The comfortable feeling when food is taken can be achieved by having healthy, safe and pleasant food that complies with our beliefs (Bublitz *et al.*, 2013).

3.2 The potential of locally fermented halal functional food

3.2.1 *Tape* (sticky rice and cassava)

Tape is a fermented carbohydrate product using yeast and bacteria, which belongs to the lactic acid bacteria (LAB) group (Sulistiani & Hidayat, 2020). BAL itself has known as GRAS (generally recognised as safe) microbes; in other words, this type of bacteria is known as a microbe that is not a health risk (Antika, 2019). Tape in Indonesia is predominantly made with essential ingredients of cassava and glutinous rice (Griana & Kinasih, 2020) and differ in any area based on its ingredients. In cassava *Tape* fermentation, the dominant microbes play a role, including *Saccharomyces cerevisiae, Saccharomycopsis fibuligera, Candida tropicalis,* and *Candida guilliermondii* (Cempaka, 2021). In fermented sticky rice, the significant microbes *Lactobacillus plantarum, Lactobacillus curvatus, Lactobacillus fermentum, Pediococcus pentosaceous, Weissella confuse, Weissella paramesenteroides, Weissella kimchi* (Hasanah *et al.*, 2019; Rahayu *et al.*, 2018). The types of microbes that play a role in fermenting cassava *Tape* and sticky rice *Tape* are dominated by lactic acid bacteria and bacteria that can potentially be probiotics. Probiotics are living organisms that can provide health effects on the body by improving the balance of the digestive tract microflora if consumed in sufficient quantities (Antika, 2019).

Various sources show that the functional potential of sticky rice and cassava *Tape* is based on the fermented compounds, as shown in Table 1.

In addition to fermented compounds, microbes that play a role in fermentation also have health functions in the presence of lactic acid bacteria and mould. In addition to maintaining the proper balance of the microflora in the digestive system, lactic acid bacteria also improve health and act as an immunomodulator. (Azizah *et al.*, 2019; Rahmah, 2021). *Saccharomyces cerevisiae*, also used in *Tape*, is known to have benefits because it can synthesise one of the metabolites beneficial to the human body, such as folic acid, which is more easily absorbed by the body (Lazo - Vélez *et al.*, 2018). One of the moulds is *Candida sp.* also can stimulate functional activity in immune cells and encourage antioxidant activity, primarily related to yeast structural polysaccharides (Cempaka, 2021; Sujaya *et al.*, 2004). Sticky rice *Tape* and cassava *Tape* use vegetable ingredients as their main ingredients, such as glutinous rice and cassava. The microbes used in making *Tape* are the fungus *Aspergillus sp.,* yeast, strain *Saccharomyces cerevisiae*, and bacteria, strain *Acetobacter aceti*, which are grown spontaneously in media and used as *Tape* yeast. Although *Tape* yeast contains different microorganisms from one brand to another, the different brands of *Tape* yeast used can affect the taste characteristics of the *Tape* so that the level of consumer preference for *Tape* produced from different yeast brands will be different. Tape based on tubers fermented using yeast consisting of a mixture of bacteria, yeast and mould is preferred by consumers compared to *Tape*, which is fermented with yeast which only contains mould (Muhiddin, Ramlawati, Yanti, & Mun'im, 2019).

One of the critical points for halalness in sticky rice and cassava *Tape* is the use of microbial starters, both of microbial origin and growth media. In yeast media for the growth of starter

Table 1: Functional potential of sticky rice *Tape* and cassava *Tape*

Substance	Function	References
β-glucan	Play a role in the process of inhibition of cancer cell growth.	(Pramesti Griana & Sekar Kinasih, 2020, Sujaya *et al.*, 2004)
β-glucosidase	It helps in increasing the total flavonoid and phenolic content.	(Nuraida, 2015; Febricia *et al.*, 2020; Jiang *et al.*, 2020)

Tape, it is made from rice flour dough with other natural additives (Asri *et al.*, 2021). Based on the Minister of Religion Decree No. 1306 of 2021, sticky rice and cassava *Tape* are included in the halal positive list, meaning all critical contamination points of haram materials can be confirmed as halal. In addition, sticky rice *Tape* and cassava *Tape* microbes can come from wrapping leaves, such as banana leaves and teak leaves (Aýun *et al.*, 2022). *Tape*, based on Indonesian MUI FATWA No. 4 of 2003, is not considered haram as long as they do not contain toxic ingredients. The ethanol content in the *Tape* that had been left for ferment up to five days increased up to 9,2% (Zainuddin *et al.*, 2022), while ethanol that is regarded as toxic has content higher than 15% solution and can be handled for industrial and medicine, but not for drinking purpose (Alzeer & Abou Hadeed, 2016)

3.2.2 *Dadih*

Dadih is a fermented local milk-based food from Minangkabau Sumatra (Sukmarini *et al.*, 2014) that is also included in the positive halal list based on the Decree of the Minister of Religion No. 1306 of 2021. Minangkabau is one of the famous ethnic groups in Indonesia (Arnold *et al.*, 2021). In Minangkabau, customary practice is based on *sharia*, and *sharia* is based on the *Qur'an* (*Adat bersandi Syarak, Syarak Bersandi Kitabullah*) (Siregar *et al.*, 2022). As their local fermented food for consumption, *Dadih* should have halal-clear status.

The milk used in *Dadih* fermentation is buffalo milk (Juniawati, Sri Usmiati, 2013). *Dadih* is obtained by simply fermenting buffalo milk in a bamboo tube, with the microbial inoculant used from nature, and fermented cassava *Tape* play a role in fermentation are dominated by the lactic acid bacteria strain *Lactobacillus plantarum*, which naturally occurs in bamboo segments (Usmiati *et al.*, 2013). In the fermented food market, *Dadih* is still far behind in sales of other fermented kinds of milk, such as yoghurt and kefir. However, regarding functional properties, the *Dadih* is not inferior to other fermented kinds of milk (Chalid & Hartiningsih, 2013). Several studies show that *Dadih* has many functional properties derived from microbial activity and active components resulting from fermentation.

Lactic acid bacteria (LAB) contained in the *Dadih* can potentially be hypocholesterolemic (Azizah & Usman, 2018); besides that, LAB in the *Dadih* is also able to improve the body's immune system (Griana & Kinasih, 2020). Furthermore, fermented *Dadih* compounds also have the potential as antioxidants and antibacterials (Chalid & Hartiningsih, 2013). The antioxidant properties result from breaking down buffalo milk proteins by enzymes produced by microbes when buffalo milk is fermented. In addition, *Dadih* can potentially prevent cancer, in this case, colon cancer, because of its antimutagenic properties, which can reduce and inhibit food-induced mutagenesis. This antimutagenic effect occurs due to a carcinogen with peptidoglycan found in the BAL cell walls in *Dadih* (Usmiati & Risfaheri, 2013). In addition, this fermentation process has a positive impact on the body because it can act as a supplier of good bacteria that function positively for the digestive tract and can also increase the number of microminerals in milk, such as calcium, magnesium, and phosphorus; and able to increase micronutrients such as folic acid, vitamin B12, and biotin.

In the process of making *Dadih*, buffalo milk was added into a glass or tube made of bamboo and covered with banana leaves tied with bamboo rope or rope made of other materials. The microbes that play a role in the processing are originated from buffalo milk or banana leaves used as cover for bamboo tubes (Sunaryanto & Marwoto, 2012). Other regions in Indonesia have also developed natural fermentation of *Dadih*, such as Bali, where the bamboo used for *Dadih* fermentation uses local Balinese *petung* bamboo (Sugitha & Puspawati, 2018). The critical points for the halalness of the *Dadih* are the milk ingredients used and the medium for making the *Dadih*. Buffaloes are animals that are halal both for their meat and milk. In contrast, the media for making *Dadih,* as well as the growth medium for microorganisms for fermenting buffalo milk, comes from nature, such as bamboo and banana leaves, are free of non-permissible substances.

Reflecting on the critical points of microbial products, one of which is growth media, it is inevitable that the microbial growth media used in making *Dadih* all come from nature, such as bamboo and banana leaves. Including *Dadih* products in the positive halal list further strengthens the public to consume them without worrying about their halal status. Apart from that, the *Dadih* also comes from fresh buffalo milk without the addition of any additional ingredients, so it can be ascertained that it is halal, according to the Decree of the Minister of Religion of the Republic of Indonesia number 1360 of 2021, which states that fresh milk is one of the ingredients that is exempt from the obligation to certify halal.

3.2.3 *Tempeh*

Tempeh is a fermented product made from legumes (soybeans) generally consumed by Indonesians (Dinar, 2013). *Tempeh* is an indigenous Indonesian fermented food originating from Java, formerly used as a food used in cultural events and traditional ceremonies (Romulo & Surya, 2021); where *Tempeh* originated from the introduction of soybeans, Chinese traders brought 1000 AD. to the island of Java(Shurtleff & Aoyagi, 2007). The fermentation process in the manufacture of *Tempeh* involves soybeans as the primary ingredient and the fungus Rhizopus sp, with the dominant fungi being *Rhizopus oligosporus* and *Rhizopus oryzae*. *Tempeh* inoculum can be obtained commercially from the fungus Rhizopus sp and rice flour (Surya & Rahayu, 2012). However, it can also be obtained naturally from the leaves of *Tempeh* wrappers, both banana and teak leaves (Aýun *et al.*, 2022). The ingredients used in making *Tempeh* can vary from soybeans and other grains, such as *benguk* beans, kara beans, red beans, *komak* beans, and green beans (Jayanti, 2019). The ingredients used in making *Tempeh* are vegetable ingredients obtained from nature. *Tempeh* undergoes a process of soaking, removing the

epidermis and steaming before finally being fermented with microbes from artificial yeast and natural ingredients.

The process that occurs in the manufacture of *Tempeh* includes the production of protease, lipase and amylase enzymes due to the growth of mould (fungi). The presence of this enzyme will play a role in breaking down proteins, ats, and complex carbohydrates into simpler compounds (Su *et al.*, 2021). *Tempeh* is locally fermented with functional potential due to bioactive components and microbes which, based on research, positively impact health, as shown in Table 2. The growth of mould (fungi). The presence of this enzyme will play a role in breaking down proteins, ats, and complex carbohydrates into simpler compounds (Su *et al.*, 2021). *Tempeh* is locally fermented with functional potential due to bioactive components and microbes which, based on research, positively impact health, as shown in Table 2.

Table 2: Bioactive components of *Tempeh*

Substance	Function	References
Vitamin B12	Being a coenzyme for metabolic processes, playing a role in the process of blood formation and improving nerve function	(Pinasti *et al.*, 2020; Redi Aryanta, 2020; Sine & Soetarto, 2018; Yarlina & Astuti, 2021; Yongsmith *et al.*, 2016)
Folic Acid, Iron	Play a role in the function of blood formation and prevent anaemia.	(Pinasti *et al.*, 2020; Yarlina & Astuti, 2021)
Isoflavones	Assists in the process of inhibiting cancer cell proliferation, acts as an antioxidant, anti-osteoporosis and helps lower cholesterol levels	(Devi *et al.*, 2021; Krisnawati, 2017; Maryam, 2015; Shetty, 2007; Siti *et al.*, 2008; Surya & Rahayu, 2012)

The critical point in making *Tempeh* is in the microbial growth medium, where the microbes used come from rice flour and are fermented by nature to obtain the expected *Tempeh* bacterial culture. The critical point of processing *Tempeh* is washing and removing the epidermis because it can be contaminated with unholy water. *Tempeh* is included in the positive list according to the Decree of the Minister of Religion of the Republic of Indonesia no 1360 of 2021 because the fermentation material did not need any helpers, additives or other ingredients. *Tempeh*'s halal status can be a unique selling point that opens opportunities for *Tempeh* marketing on a global scale because apart from being halal, *Tempeh* is also known as a superfood that has many benefits. Apart from that, *Tempeh* has also been recognised as one of the intangible cultural heritages from Indonesia and sought recognition by UNESCO, so *Tempeh*'s halal status is needed for the *Tempeh* trade on a larger scale. Natural ethanol produced by natural fermentation under aerobic conditions is halal by nature (Alzeer & Abou Hadeed, 2016). Therefore, there is no doubt about the halal status of sticky rice and cassava *Tape*: However, the ethanol content was more than 1% (Ibrahim *et al.*, 2022; Siebenhandl *et al.*, 2001). Moreover, the materials used are obtained from vegetable sources, which are fermented directly without additional ingredients (Ray & Sivakumar, 2009).

All of these fermented foods are, essentially, the common foods that are found and readily available in the market in Indonesia. Based on the ease of the fermentation process and affordability of the community, these fermented foods become popular among Indonesian Muslims. Knowledge about their functional value and halal status is needed. However, it should be noted that if the functional food undergoes further processing into other foods, such as *Tempeh* chips, *Tempeh* brownies, *Tempeh* ice cream, *Tempeh* nuggets and other food derivatives, the functional food is no longer included in the positive list. It is because the product has undergone additional physical processing and the addition of other ingredients. In addition to the processing, if the packaging and serving of functional food are no longer the same as the original processing, for example, using a ceramic-based serving utensil that has the potential to contain non-halal material contamination, then the functional food needs to be reviewed regarding its halal status (out of the positive list).

4. Conclusion

This study aims to review the functional food in Indonesia that has a clear halal status. Indonesia has shown that local fermented food in Indonesia has the potential as a functional food. Apart from having the potential as functional food, some of the fermented foods described can also be ascertained for their halal status because they are included in the list of foods that are exempt from the obligation of halal certification, meaning that the food in question does not contain critical points of haram contamination. Furthermore, technology is needed to optimise the benefits of local fermented food. Besides that, it needs the Government's support in improving production technology to improve product quality and compete with other types of fermented food.

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