

# Critical Points of Halal Antioxidants from the Perspective of the Qur'an, Science, and Health

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## Abstrak

Reaksi oksidasi pada minyak atau lemak menyebabkan perubahan struktur lemak dan menghasilkan bau tengik. Antioksidan diperlukan untuk mencegah terjadinya reaksi ketengikan. Minyak atau lemak merupakan trigliserida yang terdiri dari satu gliserol dan tiga gugus asam lemak. Asam lemak ini mudah mengalami perubahan oleh adanya reaksi dengan oksigen sehingga menghasilkan ketengikan yang tidak dikehendaki. Bahan antioksidan yang sering digunakan dalam industri minyak dan makanan berminyak bermacam-macam. Ada yang berasal dari bahan sintesis dan ada pula yang berasal dari bahan alami. Masing-masing memiliki kelebihan dan kekurangan sendiri-sendiri, baik ditinjau dari sudut halal maupun dari aspek kesehatan (thayyib). Halal menjadi sebuah keharusan dalam produk makanan di Indonesia dan diatur dalam peraturan perundang-undangan untuk melindungi umat muslim yang wajib makan makanan halal. Bahan-bahan makanan pun juga harus dijamin kehalalannya supaya produk akhir dapat diberi label halal. Kalau boleh memilih, tentunya kita lebih memilih antioksidan alami yang berasal dari bahan halal dan dilapis dengan bahan yang halal pula. Dengan demikian akan terpenuhi syarat halal dan thayyib bagi tubuh kita. Ekstrak Daun Bambu (*Bambusa sp*) merupakan salah satu Antioksidan Alami yang berasal dari Alam. Daun bambu diekstraksi dengan metode maserasi dengan pelarut etanol, kemudian ekstrak diuji aktivitas antioksidannya menggunakan metode DPPH. Antioksidan dalam Daun Bambu (*Bambusa sp*) sebesar 45,22  $\mu\text{g}/\text{ml}$ . Titik kritis kehalalan Antioksidan dapat ditinjau berdasarkan tujuan pemakaiannya, sumber bahan bakunya, dan cara pengolahannya.

**Kata Kunci:** antioksidan, ekstrak daun bambu (*bambosa sp.*), halal pangan.

## Abstract

Oxidation reactions in oil or fat cause changes in the fat structure and produce a rancid odor. So to prevent this rancidity reaction, antioxidants are needed. Oil or fat is a triglyceride consisting of one glycerol and three fatty acid groups. These fatty acids are easily changed by reaction with oxygen, resulting in unwanted rancidity. Antioxidants that are often used in the oil and oily food industry vary. Some come from synthetic materials, and some come from natural materials. Each has its own advantages and disadvantages, both in terms of halal and health aspects (Tayyib). Halal is a requirement in food products in Indonesia and is regulated in laws and regulations to protect Muslims who are required to eat halal food. Food ingredients must also be guaranteed halal so that the final product can be labeled halal. If we can choose, of course we prefer natural antioxidants that come from halal ingredients and are coated with halal ingredients as well. Thus, the Halal and Tayyib requirements for our bodies will be met. Bamboo Leaf Extract (*Bambusa sp*) is one of the Natural Antioxidants that comes from Nature. Bamboo leaves are extracted using the maceration method with ethanol solvent, then the extract is tested for antioxidant activity using the DPPH method. In this study, the Antioxidant in Bamboo Leaves (*Bambusa sp*) was obtained at 45.22  $\mu\text{g}/\text{ml}$ . The critical point of halal Antioxidants can be reviewed based on the purpose of use, the source of the raw materials, and the processing method.

**Keywords:** antioxidant, bamboo (*bambusa sp.*) leaves extract, halal food

## INTRODUCTION

Food is one of the essential needs of life. According to Islamic principles, food consumed must adhere to the standards of halalan thayyiban. The term halal refers to what is permissible and lawful under Islamic law, while thayyib denotes that the food is healthy, nutritious, pure, and safe. As consumer awareness of healthy and halal food continues to grow, the global demand for halalan thayyiban products is rapidly increasing (Tsani et al., 2021). Moreover, many food companies worldwide are entering the halal market, which has become a large, attractive, and highly competitive sector.

In addition, the development of halalan thayyiban products is closely linked to the use of antioxidant compounds. Antioxidants are substances that, even in low concentrations relative to oxidizable substrates, can significantly delay or inhibit the process of oxidation (Kasote et al., 2015). Alternatively, antioxidants can be defined as compounds that donate one or more electrons to oxidizing agents, thereby preventing oxidative damage to target molecules. Various phenolic and flavonoid compounds found in local plants have been reported to possess high antioxidant capacities and contribute significantly to human health (Sukweenadhi et al., 2020). For instance, bamboo leaves contain active compounds such as phenolics and flavonoids, which serve as essential sources of phytochemicals. These properties have driven innovations in halal and healthy food products, including product formulation, halal certification, and shelf-life extension (Ramadhan et al., 2024).

The formation of more stable oxidant compounds is through intramolecular hydrogen bonds in the further oxidation process. Antioxidant activity is effective in various ways, namely as an inhibitor of free radical oxidation reactions by inhibiting the formation of free lipid radicals, by disrupting the propagation of antioxidation chain reactions, through synergy with other antioxidants, as a reducing agent that converts hydroperoxides into stable compounds, as a metal chelator that converts pro-oxidant metals (iron and copper derivatives) into stable products, and also as an inhibitor of pro-oxidative enzymes (Lü et al., 2010).

Types of antioxidants based on their sources are divided into natural/endogenous antioxidants and exogenous antioxidants. Included in the type of natural antioxidants are enzymatic antioxidants such as copper, zinc, manganese superoxide dismutase, glutathione peroxidase, glutathione reductase, and catalase, while types of non-enzymatic antioxidants include glutathione, ubiquinol, selenium, lipoic acid, and others. Other sources of antioxidants (exogenous antioxidants) that have been widely studied include ascorbic acid (vitamin C) and tocopherol (vitamin E)

(Ponnampalam et al., 2022). Both types of vitamins can be obtained from vegetables and fruits in addition to other compositions contained in them such as polyphenols, phenolic acids, and flavonoids which can also function as antioxidants. This is also supported by the results of research showing that the provision of vitamin E intake to 4000 non-diabetic subjects for 23 years provided significant results related to reducing the risk of Diabetes (Zeng et al., 2023).

One of the plants that has the potential to be developed as an antioxidant is bamboo leaves (*Bambusa Sp.*). In recent years, in-depth research on bamboo has found that bamboo leaves are rich in various bioactive components, including flavonoids, polysaccharides, amino acids, phenolic acids, essential oils that show various pharmacological activities. For example, ethanol extract of *Bambusa Sp.* leaves has antihyperglycemic effects through antioxidant activity and protecting pancreatic  $\beta$ -cells. Bamboo leaf extract (*Bambusa Sp.*) was observed to reduce fat absorption in rats and increase fat excretion through feces (Apridamayanti, 2021).

In addition, Bamboo Leaves are defined as functional beverages with several biological properties such as antioxidant activity, antithrombosis, fibrinolytic activity, antiaging, and antihypertensive (Tundis et al., 2023). Therefore, further research may be needed to confirm the effect of heat on antioxidant release and study more effects on health benefits. Furthermore, product development is needed to maintain bioactive compounds and extend the shelf life of the product (Arias et al., 2022).

## METHODS

### Material Preparation

Bamboo leaves were washed, drained and dried at 50 C using a cabinet drier for 24 hours. The dried leaves were ground and sieved to obtain bamboo leaf powder that passed a 60 mesh sieve size, stored until further analysis (Burney, 2010).

### Extraction

Bamboo leaf powder was extracted by maceration method using 80% methanol (1 : 8 w/v) at room temperature for 48 hours. Then filtered using filter cloth and filter paper (Whatman No. 41). The filtrate was extracted using a rotary vacuum evaporator at 40°C to obtain a crude extract of bamboo leaves (Ibrahim & Kebede, 2020).

## Antioxidant Activity Test

The antioxidant activity of the extract was carried out using the DPPH method. A sample of 1 mL of bamboo leaf extract solution with a concentration of 1 mg/ml was mixed with DPPH dissolved in methanol (23 mg/L). The sample was vortexed and its absorbance was measured at a wavelength of 515 nm every 10 minutes until constant using a UV-Vis spectrophotometer (Baliyan et al., 2022).

Antioxidant activity is calculated using the equation:

$$\%RSA = \frac{\text{Abs Blanko} - \text{Abs Sampel}}{\text{Abs Blanko}} \times 100\%$$

## Total Phenolic Test

The total phenolic content in bamboo leaf extract is expressed in mg gallic acid equivalents (mgGAE/g bamboo leaf extract). The analysis was carried out by making a standard curve first. The standard curve was made by making a gallic acid solution with a concentration of 0.00; 0.02; 0.04; 0.06; 0.08; 0.10 mg/ml. The gallic acid solution was taken as much as 1 ml. Then added 5 ml of Na<sub>2</sub>CO<sub>3</sub> solution (2%) and vortexed. The solution was left for 10 minutes. Then added 0.5 ml of Folin-Ciocalteu solution (50%) and vortexed. The solution was incubated for 30 minutes. Furthermore, the absorbance of the sample solution was measured at a wavelength of 760 nm with a uv-vis spectrophotometer. For samples, the steps are the same as making a standard curve. The sample is dissolved at a concentration of 0.1 mg/ml ethanol (Roy et al., 2024).

## Total Flavonoid Test

The total flavonoid content in bamboo leaf extract is expressed in mg quercetin equivalent (mgQE/g Bamboo leaf extract). The analysis was carried out by making a standard curve first. The standard curve was made by making a quercetin solution with a concentration of 0.0; 0.1; 0.2; 0.3; 0.4; 0.5; 0.6; 0.7; and 0.8 mg/ml. The quercetin solution was taken as much as 0.2 ml. Then 0.8 ml of distilled water and 0.05 ml of NaNO<sub>2</sub> (5%) were added. The solution was vortexed and then incubated for 6 minutes. AlCl<sub>3</sub> (10%) as much as 0.1 ml was added to the solution, then vortexed and incubated for 5 minutes. 0.5 ml of 1 M NaOH was added. Then 0.85 ml of distilled water was added and vortexed. The absorbance of the solution was measured at a wavelength of 510 nm. For the sample, the steps taken were the same as for making the standard curve. The sample was dissolved at a concentration of 0.1 mg/ml ethanol (Chandra et al., 2014).

## RESULTS AND DISCUSSION

Bambusa leaves are derived from natural materials that possess positive biological properties due to their content of vitamins and phytochemicals. These leaves contain several compounds that act as antioxidants, such as flavonoids, phenolic compounds, and capsaicinoids (Putra, 2024). This variety of bamboo leaves is Apus reported to be rich in natural antioxidants, as evidenced by its high levels of polyphenols, flavonoids, and antioxidant activity. In this study, the extracted bamboo leaves exhibited high phenolic and flavonoid values, as well as DPPH radical scavenging properties comparable to the standard. Therefore, the results of this study suggest that Halal-certified Bamboo Leaf Extract can be considered a halal and thayyiban food with health benefits, particularly due to its antioxidant activity and other biological properties. Furthermore, the results of this research indicate that the Total Phenolic Content (TPC), Total Flavonoid Content (TFC), and radical scavenger activity (DPPH) were significantly higher than those reported in other studies, such as those by Tundis et al. (Tundis et al., 2023).

The drying process of bamboo leaves is carried out for 48 hours at a temperature of 50°C. With a long drying process, bamboo leaf extract has an antioxidant activity of 45.23 ± 0.70% RSA at an extract concentration of 0.01 g / 10 ml. This value is quite low when compared with the antioxidant activity of BHT, namely 35.64% RSA at a concentration of 0.01 BHT /100 mL. Based on this data, it can be said that the antioxidant activity value of bamboo leaf extract is also influenced by the origin of the bamboo tree used.

The antioxidant activity test results of the ethanol extract of bamboo leaves are shown as the percentage of inhibition of DPPH free radicals and compared with the antioxidant activity of BHT (Table 1). Based on the % inhibition value of the sample and BHT at various concentrations, the IC<sub>50</sub> value can be obtained. The smaller the IC<sub>50</sub> value, the higher the antioxidant activity in the sample. Test results show that BHT as a standard synthetic antioxidant has an IC<sub>50</sub> of 9.54 µg/mL and ethanol extract of bamboo leaves has an IC<sub>50</sub> of 45 µg/mL, meaning that at a concentration of 45 µg/mL the extract can inhibit 50% of free radicals (Arifani et al., 2021).

These results suggest that the sterilization process may involve phenolic values, flavonoids, and radical scavenger capacity. These results are consistent with, which reported that heat treatment significantly affected TPC and DPPH. They suggested that high heat treatment may enhance the extraction of phenolic compounds by disrupting the plant cell wall, which may release phenolic compounds more easily from Bamboo Leaves (Muflihah et al., 2021). The bound

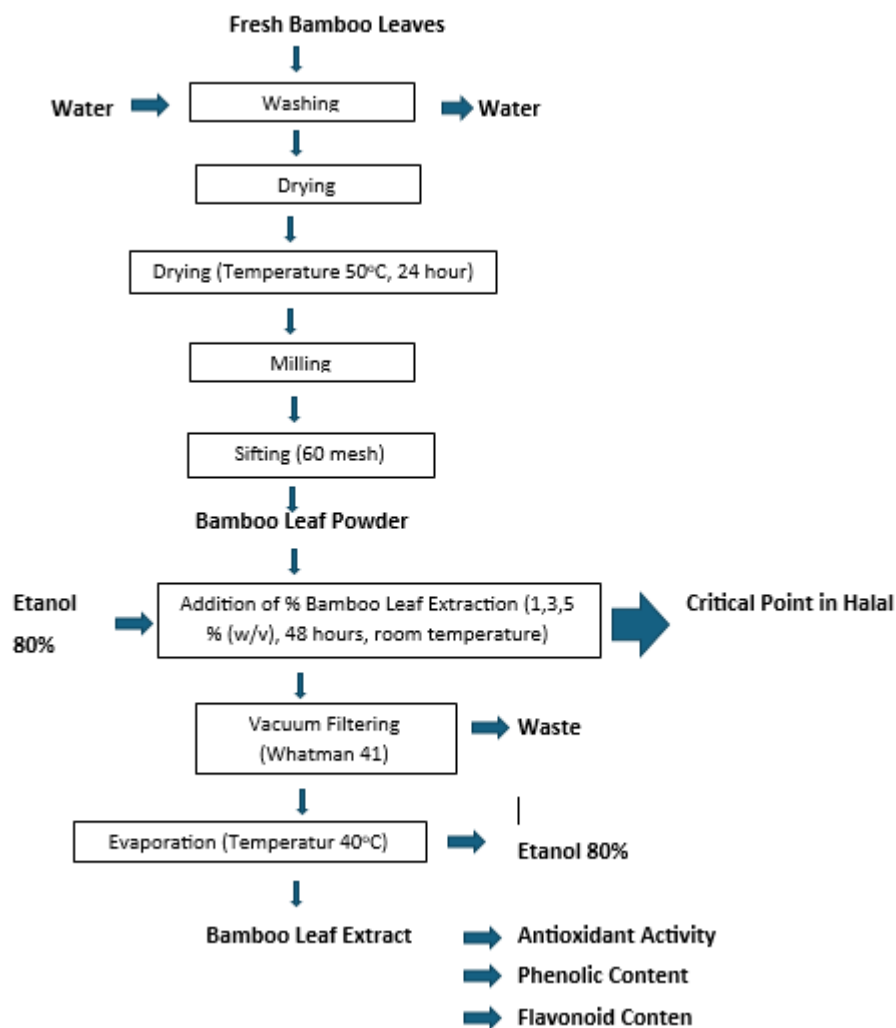


Figure 1: Diagram Process of Bamboo Leaf Extract (Arifani et al., 2021)

Table 1: Antioxidant, Flavonoid and Phenolic Results (Arifani et al., 2021)

Parameter	Results
Antioxidant Activity of Bamboo leaf extract	45.23 ± 0.70 % RSA
Antioxidan Activity BHT	35.64 ± 0.44 % RSA
IC 50 Bamboo leaf extract	46.87 ppm
IC 50 BHT	9.5454 ppm
Total Fenolic content	157.42 ± 7.95 mg GAE/ g ekstrak DBH
Total Flavonoid content	19.40 ± 4.01 mg QE/g ekstrak DBH

polyphenolic and flavonoid compounds may be released by heat treatment, leading to an increase in the polyphenolic and flavonoid contents. In addition, Bamboo Leaves are defined as functional foods with several biological properties such as antioxidant activity, antithrombosis, fibrinolytic activity, antiaging, and

antihypertensive.

Bamboo Leaves extracts exhibit anti-inflammatory and antioxidant properties of bioactive compounds found in spice and herbal elements. Therefore, further studies may be needed to confirm the effect of heat on antioxidant release and study more effects on

health benefits. Furthermore, product development is needed to maintain bioactive compounds and extend the shelf life of products (AN et al., 2016).

The halalness of a product is a hot topic among the public, especially in food products. The era of modernization has caused people to tend to imitate types of food that do not only come from their area of origin. Muslim communities because of the existence of halal reasons are their priority in choosing the food to be consumed. Apart from the religious aspect, the halalness of food products must also be a priority for everyone, because halal food contains good nutrition for the body so that it is not misinterpreted. In addition, the prohibition of a certain food indicates that the food tends to cause disease if consumed (Purnomo et al., 2024). Food can be categorized as halal if it is made from halal ingredients and processed with a good process. In addition, the mixture added to the food can also affect the halalness of the food because additional ingredients will contaminate it if added. For example, someone wants to consume vegetables that will be cooked through several processes and when sautéing the spices, a few drops of pork oil are added which is clearly forbidden by law for consumption. Although vegetables are halal for consumption, other food ingredients used in the cooking process affect the status of the food. Therefore, food that was originally halal will become haram due to contamination from food additives (Jannah et al., 2023).

Some food additives come from natural products such as antioxidants. Thus, oleoresin is a chemical substance consisting of essential oils and resins. While antioxidants are used to ward off free radicals. Antioxidants are essential for the body to overcome and prevent oxidative stress. Various natural ingredients native to Indonesia contain many antioxidants with various active ingredients. The use of natural ingredients native to Indonesia as antioxidants is needed to improve the quality of public health at a relatively affordable cost (Lourenço et al., 2019).

Natural ingredients (natural products) are very easy to find in various countries, especially Indonesia. In addition to being easy to find and having a relatively affordable price, natural ingredients are very popular with the public because they are rich in functions. It is very important to understand the critical halal point of natural product ingredients and other food additives. By knowing the critical point of a material, the public can be wiser in processing food. In addition, the public can play a more active role in determining alternative food additives for daily needs or creating innovations in the food industry (Badawi et al., 2023).

Antioxidants are easily oxidized by free radicals so that other molecules in cells can be protected from damage caused by free radicals or reactive oxygen. Antioxidant molecules can dissolve in fat and water.

Fat-soluble antioxidants will dissolve in the cell membrane while other antioxidants that dissolve in water will dissolve in the fluids outside and inside the cell. Compounds containing antioxidants have a role and can work together with other antioxidants in the body, exchanging benefits, and providing protection to the body so it is important to consume. Some antioxidant content is found in vegetables and fruits. Some molecules that are antioxidants also act as vitamins A, C, and E (Lobo et al., 2010).

Vitamin A is found in milk, butter, eggs, and liver. Vitamin C is found in kiwi fruit, oranges, papaya, broccoli, tomatoes, cauliflower, kale, beta-carotene. Vitamin E is found in various nuts and seeds, such as: almonds, hazelnuts, sunflower seeds, and peanuts (Michalak et al., 2021).

These various foods are consumed almost every day by the public, especially in Indonesia. One of the antioxidants is capsaicin. Capsaicin is usually found in chili sauce products. The critical halal points of chili sauce products include auxiliary ingredients such as granulated sugar, cooking oil, and monosodium glutamate (MSG). Cooking oil in the manufacturing process uses vegetable oil as the basic ingredient by involving bleaching earth. Bleaching earth contains activated carbon which is generally made from pork bones. Given the critical halal points, this oil must have a halal certificate (Azlan et al., 2022).

The critical point of halalness of natural products can be reviewed from:

### **Based on its purpose**

The processing of natural products containing antioxidants should be used for good purposes, namely having a beneficial value. If the processing of natural products containing antioxidants is used for bad purposes, for example alcoholic beverage products, which are haram for consumption according to sharia, then the status of processed food from these natural products becomes haram (Rahaman et al., 2023).

### **Based on the source**

Based on the Decree of the Minister of Religion (KMA) Number 1360 of 2021, for natural materials that come directly from the plant itself, the status is halal for consumption even though the fertilizer used comes from manure (living creature waste). Some examples of antioxidant materials that are taken directly from the tree include tomatoes, broccoli, papaya, kale, cauliflower, kiwi, and various nuts and seeds. Meanwhile, for natural products that contain antioxidants and come from animals, it is certain that the animals that produce them are in healthy condition so that the natural products produced do not cause harm in

the form of disease. The natural products in question include milk, eggs, and liver from cows or chickens (Arifin & Hatoli, 2021).

### Based on the processing process

In creating food products, several processing processes are needed with various food sources. No exception, the food sources come from the examples of food ingredients mentioned earlier. The antioxidants contained in these food sources make the community and the industrial sector very often use them to produce food products with different processing. The processing process must go through a process that is halal according to sharia, without a mixture of other food ingredients that are unclean, and processed in clean or hygienic places so as not to cause disease. In addition, the storage process must be considered so that the food does not ferment which can cause the halal status of the food to change (Ahmad & Al-Shabib, 2020).

The manufacture of extracts begins with the preparation of raw materials, extraction using solvents, evaporation, and calculation of the yield. Ethanol solvent is one of the solvents used in the extraction process. Oleoresin when traded, can also be added with emulsifiers. Ethanol comes from by-products of the khamr industry and non-khamr industrial products such as in the petrochemical industry. Based on the MUI Fatwa Number 10 of 2018 concerning Food and Beverage Products Containing Alcohol or Ethanol, the scholars issued a decision based on the VII MUI Ulama Ijtima in 2021 which contains (Fajriati et al., 2022):

1. Alcohol/ethanol from the khamr industry, the law of which is the same as the law of khamr, namely haram and najis.
2. Alcohol/ethanol from the non-khamr industry (either the result of chemical synthesis based on petrochemicals or the result of the non-khamr fermentation industry), the law is not najis and if used in non-beverage products, the law is permissible (if it is not medically dangerous) (Mz, 2019).

In Surah Al Maidah Verse 90:

يَا أَيُّهَا الَّذِينَ آمَنُوا إِنَّمَا الْخَمْرُ وَالْمَيْسِرُ وَالْأَنْصَابُ وَالْأَزْلَامُ  
رِجْسٌ مِّنْ عَمَلِ الشَّيْطَانِ فَاجْتَنِبُوهُ لَعَلَّكُمْ تُفْلِحُونَ

Meaning: O you who believe, indeed drinking, gambling, (berk urban for) idols, and drawing lots of

fortunes with arrows is an abominable act (and) includes the act of Satan. So, stay away from those (actions) so that you will be lucky.

This is based on the words of the Prophet Muhammad SAW:

وَعَنِ ابْنِ عُمَرَ رَضِيَ اللَّهُ عَنْهُمَا قَالَ: قَالَ رَسُولُ اللَّهِ صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ: «كُلُّ مُسْكِرٍ خَمْرٌ وَكُلُّ مُسْكِرٍ حَرَامٌ وَمَنْ شَرِبَ الْخَمْرَ فِي الدُّنْيَا قَمَاتَ وَهُوَ يُدْمِنُهَا لَمْ يَتُبْ لَمْ يَشْرَبْهَا فِي الْآخِرَةِ»  
رَوَاهُ مُسْلِمٌ .

Narrated from Ibn Umar (may Allah be pleased with him), the Prophet (peace and blessings be upon him) said: "Everything that intoxicates is khamr (intoxicant), and all khamr is forbidden." (Narrated by Muslim)

According to Ahmad Muhammad Assaf, there has been a consensus among scholars regarding the prohibition of khamr and various types of intoxicating drinks.

The word khamr (alcoholic drink), fermented fruit, is mentioned in the Koran 6 times; al-khamr refers to a solution, which is produced from fruit or other natural sugar sources through anaerobic fermentation and is potentially usable or intoxicating. The main ingredient of al-khamer is ethanol, which is a chemical that causes intoxication, a physiological state caused by ethanol consumption in which a person usually becomes relaxed, relieved. If the ethanol content is less than 1%, then ethanol is an important preservative, therefore in this study the halal status is permissible, permitted as long as the ethanol is formed naturally through a fermentation process in the presence of oxygen, or added synthetically ethanol (Adiansyah & binti Yahya, 2023).

## CONCLUSION

Bamboo Leaf Extract showed a positive biological role in antioxidant activity, as indicated by the high values of phenolics, flavonoids, and free radical scavengers (DPPH). Incidentally, the sterilization effect involved an increase in phenolic, flavonoid, and radical scavenging activity. From the data presented here, it can be assumed that Halal certified leaf extract meets the trend of healthy food. It is classified as halal and thayyiban food that is suitable for Muslim health lovers. And Ethanol, has been classified into three categories, namely preservatives, non-halal, and toxic. If the ethanol content is less than 1%, then ethanol is considered an essential preservative, therefore in this study its halal status is mubah, permissible as long as ethanol is formed naturally through a fermentation process in the presence of oxygen, or added as synthetic ethanol.

## References

- Adiansyah, R. & binti Yahya, N. F. (2023). Khamr in the qur'an (thematic study of tafsir ibn jarir al-tabari). *QiST: Journal of Quran and Tafseer Studies*, 2(1):1–17, DOI: <https://doi.org/10.23917/qist.v2i1.1208>.
- Ahmad, S. & Al-Shabib, N. A. (2020). *Functional Food Products and Sustainable Health*. Springer.
- AN, X. P., Diwan, A., & Chandra, S. (2016). Flavonoids: an overview. *J nutr Sci*, 5.
- Apridamayanti, P. (2021). Identification and activity of active compound of bamboo leaves (*bambusa vulgaris schrad ex. jc*) ethanolic extract against diabetic ulcers gram-negative bacteria from diabetic ulcer's patient. *Jurnal Ilmiah Farmasi*, 17(1):96–106, DOI: 10.20885/jif.vol17.iss1.art10.
- Arias, A., Feijoo, G., & Moreira, M. T. (2022). Exploring the potential of antioxidants from fruits and vegetables and strategies for their recovery. *Innovative food science & emerging technologies*, 77:102974.
- Arifani, E. N., Santoso, U., & Supriyadi, S. (2021). The correlation of the total phenolic and flavonoid content on its antioxidant and antimicrobial activity of bamboo leaf extract. *Key Engineering Materials*, 884:256–263, DOI: <https://doi.org/10.4028/www.scientific.net/KEM.884.256>.
- Arifin, Z. & Hatoli, H. (2021). Application of halal certification by Indonesian ulema council on electronic and non-consumption products: Masalahah perspective. *Justicia Islamica*, 18(1):115–131, DOI: 10.21154/justicia.v18i1.2397.
- Azlan, A., Sultana, S., Huei, C. S., & Razman, M. R. (2022). Antioxidant, anti-obesity, nutritional and other beneficial effects of different chili pepper: A review. *Molecules*, 27(3):898, DOI: <https://doi.org/10.3390/molecules27030898>.
- Badawi, A. K., Salama, R. S., & Mostafa, M. M. M. (2023). Natural-based coagulants/flocculants as sustainable market-valued products for industrial wastewater treatment: a review of recent developments. *RSC advances*, 13(28):19335–19355, DOI: 10.1039/D3RA01999C.
- Baliyan, S., Mukherjee, R., Priyadarshini, A., Vibhuti, A., Gupta, A., Pandey, R. P., & Chang, C.-M. (2022). Determination of antioxidants by dpph radical scavenging activity and quantitative phytochemical analysis of *ficus religiosa*. *Molecules*, 27(4):1326, DOI: <https://doi.org/10.3390/molecules27041326>.
- Burney, S. L. B. (2010). *Determination of antioxidant and total phenolic content of Pueraria lobata and evaluation of novel food products containing kudzu*. Mississippi State University.
- Chandra, S., Khan, S., Avula, B., Lata, H., Yang, M. H., ElSohly, M. A., & Khan, I. A. (2014). Assessment of total phenolic and flavonoid content, antioxidant properties, and yield of aeroponically and conventionally grown leafy vegetables and fruit crops: A comparative study. *Evidence-Based Complementary and Alternative Medicine*, 2014(1):253875, DOI: <https://doi.org/10.1155/2014/253875>.
- Fajriati, I., Ikhsani, A. Y., Monitasari, A., Zamhari, M., Kartika, B., & Subba, J. R. (2022). The effect of extraction method on the extract yield in the carotenoid pigment encapsulation for halal natural pigment. *Indonesian Journal of Halal Research*, 4(2):97–106, DOI: 10.15575/ijhar.v4i2.17188.
- Ibrahim, N. & Kebede, A. (2020). In vitro antibacterial activities of methanol and aqueous leaf extracts of selected medicinal plants against human pathogenic bacteria. *Saudi Journal of Biological Sciences*, 27(9):2261–2268, DOI: <https://doi.org/10.1016/j.sjbs.2020.06.047>.
- Jannah, A. W., Inayatulloh, H. M., Mumtazah, M., Supriyatna, A., & Cahyanto, T. (2023). Halal critical point analysis of some toast samples in cibiru district, Bandung city. *Jurnal Penelitian Ilmu Ekonomi dan Keuangan Syariah*, 1(3):73–82.
- Kasote, D. M., Katyare, S. S., Hegde, M. V., & Bae, H. (2015). Significance of antioxidant potential of plants and its relevance to therapeutic applications. *International Journal of Biological Sciences*, 11(8):982–991, DOI: <https://doi.org/10.7150/ijbs.12096>.
- Lobo, V., Patil, A., Phatak, A., & Chandra, N. (2010). Free radicals, antioxidants and functional foods: Impact on human health. *Pharmacognosy reviews*, 4(8):118, DOI: 10.4103/0973-7847.70902.
- Lourenço, S. C., Moldão-Martins, M., & Alves, V. D. (2019). Antioxidants of natural plant origins: From sources to food industry applications. *Molecules*, 24(22):4132, DOI: <https://doi.org/10.3390/molecules24224132>.
- Lü, J.-M., Lin, P. H., Yao, Q., & Chen, C. (2010). Chemical and molecular mechanisms of antioxidants: experimental approaches and model systems. *Journal of cellular and molecular medicine*, 14(4):840–860, DOI: <https://doi.org/10.1111/j.1582-4934.2009.00897.x>.



- Michalak, M., Pierzak, M., Kręcis, B., & Suliga, E. (2021). Bioactive compounds for skin health: A review. *Nutrients*, 13(1):203, DOI: <https://doi.org/10.3390/nu13010203>.
- Muflihah, Y. M., Gollavelli, G., & Ling, Y.-C. (2021). Correlation study of antioxidant activity with phenolic and flavonoid compounds in 12 Indonesian indigenous herbs. *Antioxidants*, 10(10):1530, DOI: <https://doi.org/10.3390/antiox10101530>.
- Mz, R. D. R. (2019). Alcohol and khamr in fiqh based on science perspective. *International Journal of Islamic Studies and Humanities*, 2(1):1.
- Ponnampalam, E. N., Kiani, A., Santhiravel, S., Holman, B. W., Lauridsen, C., & Dunshea, F. R. (2022). The importance of dietary antioxidants on oxidative stress, meat and milk production, and their preservative aspects in farm animals: Antioxidant action, animal health, and product quality—invited review. *Animals*, 12(23):3279, DOI: <https://doi.org/10.3390/ani12233279>.
- Purnomo, I. A., Pratikto, H., & Suharsono, N. (2024). The influence of halal certification and halal awareness on purchasing decisions. *East Asian Journal of Multidisciplinary Research*, 3(4):1567–1578, DOI: <https://doi.org/10.55927/eajmr.v3i4.8861>.
- Putra, J. (2024). Antioxidant capacity, toxicity, phytochemicals, total alkaloids and phenolic levels bamboo shoot extract (*bambusa vulgaris*). *Jurnal Impresi Indonesia*, 3(7):571–579, DOI: <https://doi.org/10.58344/jii.v3i7.5297>.
- Rahaman, M. M., Hossain, R., Herrera-Bravo, J., Islam, M. T., Atolani, O., Adeyemi, O. S., Owolodun, O. A., Kambizi, L., Daştan, S. D., Calina, D., et al. (2023). Natural antioxidants from some fruits, seeds, foods, natural products, and associated health benefits: An update. *Food science & nutrition*, 11(4):1657–1670, DOI: <https://doi.org/10.1002/fsn3.3217>.
- Ramadhan, Y., Darmawan, R., Nasihin, A. K., & Sabani, N. (2024). Investigating the influence of halal certification on millennials' purchase intention and brand loyalty in the Indonesian food industry. *Indonesian Journal of Business & Entrepreneurship*, 10(2):444–454, DOI: [10.17358/IJBE.10.2.444](https://doi.org/10.17358/IJBE.10.2.444).
- Roy, M., Shourove, J. H., Singha, R., Tonmoy, T. A., Biswas, G. C., Meem, F. C., John, P. H., Samadder, M., & Al Faik, M. A. (2024). Assessment of antioxidant and antibacterial efficacy of some indigenous vegetables consumed by the manipuri community in sylhet, bangladesh. *Heliyon*, 10(18).
- Sukweenadhi, J., Setiawan, F., Yunita, O., Kartini, K., & Avanti, C. (2020). Antioxidant activity screening of seven Indonesian herbal extract. *Biodiversitas*, 21(5):2062–2067.
- Tsani, A. F., Susilo, H., Suyamto, S., Setiawan, U., & Sudanto, S. (2021). Halal and thayyib food in Islamic sharia perspective. *International Journal Mathla'ul Anwar of Halal Issues*, 1(1):97–109.
- Tundis, R., Augimeri, G., Vivacqua, A., Romeo, R., Sicari, V., Bonofiglio, D., & Loizzo, M. R. (2023). Anti-inflammatory and antioxidant effects of leaves and sheath from bamboo (*Phyllostachys edulis* J. Houz). *Antioxidants*, 12(6):1239, DOI: <https://doi.org/10.3390/antiox12061239>.
- Zeng, Y., Zhou, W., Yu, J., Zhao, L., Wang, K., Hu, Z., & Liu, X. (2023). By-products of fruit and vegetables: Antioxidant properties of extractable and non-extractable phenolic compounds. *Antioxidants*, 12(2):418, DOI: <https://doi.org/10.3390/antiox12020418>.