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Mini Review on *Halal* Food Colourants and Potential Sources

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Abstract

According to *Qur'an*, every *Muslim* must ensure that their food comes from *Halal* sources. In addition, being taught to be conscious that food and goods must be *Halal*, *Muslim*s must also be cognizant of the quality. The rest of the world is gradually beginning to see the significance of the *Muslim* need for *Halal* food and other consumables. For example, Malaysia, a diverse *Muslim* country, has a broad selection of *Halal* products and services and a high standard for food quality. As a result of the expansion of the food industry, societies now have access to a wide range of food products, including common foods, confections, desserts, and snacks. Despite the recent reduction in the permissible amount of synthetic colourants for consumer health reasons, many distinct synthetic food dyes continue to be widely utilised due to their low cost, high efficiency, and outstanding stability. Industry and customer awareness of *Halal* food and its quality should be evident. Hence, this paper aims to understand the issue and *Halal* concept in food. Focusing on food colourants sources and acknowledging the *Halal* standard in Malaysia. Based on the finding from this study, the concept of *Halal* should be combined with safety and health for consumer health, and there is a need for research into new resources for *Halal* colourants, particularly from natural colourant pigments compared to synthetic colourants.

1. Introduction

The world community has just begun to recognise the significance of *Halal*, a *Muslim* requirement for food and other consumables. The *Halal*-certified food and products market is booming (Majid *et al.*, 2015). Although the term *Halal* has never received as much attention as in recent years, a *Halal* food market exists wherever there are *Muslim* consumers whose food preferences are governed by *Halal* laws. The Economic Planning Unit of the Prime Minister's Department reported that the *Halal* market would contribute 8.1% of GDP by generating exports of RM56 billion by 2025. The *Halal* industry contributed RM9.7 billion to the country's gross domestic product in 2020 alone. According to Datuk Tan Tian Meng, secretary general of the Associated Chinese Chambers of Commerce and Industry of Malaysia (ACCCIM), this is due to non-*Muslim* consumers realising the importance of *Halal* certification for their trend of healthy eating and safe consumption compared to non-halal products. He added that the recent development and expansion of the *Halal* market had altered the perception and acceptability of non-*Muslim* consumers towards *Halal* consumption. Even non-*Muslim*s now realise and appreciate that *Halal* and *Toyyib* products are not limited to pork lard and alcohol but cover the whole process of producing the product of the highest quality benefits all consumers. Consequently, this explains why demand continues to rise year after year.

As a result of *Shari'ah* law, the *Islamic* dietary and consumption system is different and unique compared to other ethnic dietary systems. In a previous address, the former deputy minister in charge of *Islamic* Affairs stated that *Muslim*s worry more about *Halal* food than *Halal* income. This statement is consistent with the findings reported by Abdullah and Ireland in 2012, in which 49% of the respondents were highly concerned about the presence of alcohol in their perfume, makeup, and cosmetics, as well as the contamination of these goods with pig and other animal derivatives. Meanwhile, according to Jalil *et al.* (2018), *Muslim*s are more likely than other religious groups to view the humane and respectful treatment of animals in *Halal* as significant, as the *Qur'an* prohibits animal cruelty. Every *Muslim* must ensure that the food and drink they consume comes from *Halal* sources. This entails checking the ingredients and ensuring that the process adheres to *Shari'ah* principles. Due to the difficulty of tracking the source of various ingredients used to make food, drink, or other consumable items, many *Muslim* consumers rely on the ingredients on the exterior package to facilitate selecting *Halal* items. Since so many products are on the market nowadays, the issue becomes more complicated when numerous ingredients are listed in their scientific nomenclature. Especially considering that only some buyers comprehend technical phrases, the need for more comprehension of the employed codes is even worse. *Muslim*s are required to consume *Halal* food and avoid *Shubhah*.

According to MS1500: 2019 third revision, synthetic food colourants should be declared *Halal* because they comply with all the requirements for food or ingredient to be considered *Halal*. However, *Halal* food does not necessarily be *Toyyib*. We are all aware that the *Halalan Toyyiban* concept requires more than merely *Halal* and must include safety and not harm. Since synthetic food colourants cause more harm than good, it is time to find safe alternatives. Generally, synthetic colourants can be classified into water-soluble and fat-soluble colourants based on their solubility. Consumers concerned about synthetic colourants' safety urge food manufacturers to substitute synthetic colourants with natural colouring. Recently, The European Union (EU) required that all food manufacturers put a warning label on products containing the 'Southampton six colourant' (Munawar & Jamil, 2014). These colourants, known as tartrazine, quinoline yellow, sunset yellow, carmoisine, ponceau red, and Allura red, may cause intolerance reactions in sensitive individuals and adverse effects on children's behaviour, although robust scientific evidence is still lacking (Abbey, 2014). Thus, the nutritional value of the food must also be emphasised in the *Halalan Toyyiban* concept, and *Halal* food that can cause health problems should be avoided.

2. The *Halal* concept in food production

Halal food does not contain any ingredients that *Muslim*s are forbidden to consume. In today's modern age, the definition of *Halal* must go beyond simply designating "pork-free" food in its physical form. Instead, it encompasses various elements, including emulsifiers, additional food components such as gelatin, enzymes, lecithin, and glycerin, and additives such as stabilisers, flavouring, and colouring (Khan *et al*., 2016). In *surah al-Baqarah* verses 168, *Islam* establishes two fundamental standards for food consumption:

> *"O humanity! Eat from what is lawful and good on the earth and do not follow Satan's footsteps. He is truly your sworn enemy."* (2:168)

... meaning *Halal* (permitted by the *Shari'ah*) and *Toyyib* (of good quality), whereas *surah al-Baqarah* verses 172 to 173 "O believers! Eat from the good things We have provided for you. And give thanks to *Allah* if you ˹truly˺ worship Him ˹alone˺. He has only forbidden you ˹to eat˺ carrion, blood, swine, and what is slaughtered in the name of any other than *Allah*. However, if someone is compelled by necessity—neither driven by desire nor exceeding immediate need—they will not be sinful. Surely *Allah* is All-Forgiving, Most Merciful." These verses (2:172-173) state that every *Muslim* is obligated to eat *Halal* food and avoid what has already been forbidden (Md Shariff *et al*., 2021). In addition to being instructed to be conscious that food and items must be *Halal*, *Muslim*s must also be aware of what pertains to the quality. The Prophet Muhammad (PBUH) also emphasised this issue in many traditions (*Hadith*s). The Prophet's guidelines show that Islam stresses the quality of food (*Toyyib*) consumed by its believers. Every law in the *Qur'an* is understood to have a rationale and should not be taken for granted (Zakaria, 2008).

3. *Halal* recognition in Malaysia and futures

Malaysia is increasingly acknowledged as the global centre of the *Halal* industry. Despite being a multi-religious and multiracial nation, the objective of making the country's *Halal* industry a role model for other countries is highly ambitious (Md Shariff *et al*., 2021). Malaysia is striving to reach the goal to accomplish the stated objective. This is demonstrated by the annual budget, which is presented annually and allocates a specific amount of money towards *Halal* development. This demonstrates that the government has deliberately provided incentives for planning and achieving this goal. In Malaysia, a multiracial *Muslim* nation, *Halal* goods and services are easily accessible and widely available. However, the authority must also supervise and enforce guidelines to ensure the authenticity of *Halal*, particularly when the goods or services are produced, distributed, prepared, or offered by non-*Muslim*s (Dollah *et al*., 2012). Several certifications or *Halal* labelling regulations have been implemented in Malaysia. According to Ismail, Othman, Rahman, Kamarulzaman, & Rahman (2016), *Halal* certification examines every element of the production, not only its materials or components. This is consistent with *Toyyib*an, which is wholesomeness as a strength of *Halal* in food production to provide sanitation and safety products that all customers, including non–*Muslim*s, can appreciate. These characteristics are crucial marketing features for the entire consumer population. Malaysia's *Halal* laws are rapidly evolving to keep up with the country's booming *Halal* market, as seen by the following list of guidelines pertinent to *Halal* regulations in Malaysia (Azis Jakfar Soraji, Mohd Daud Awang, & Ahmad Nasir Mohd Yusoff, 2017):

i. The Trade Descriptions (Certification and Marking of *Halal*) 2011,
ii. The Trade Descriptions (Definition of *Halal*) 2011,
iii. The Rules of the Trade Descriptions (Fi Certification and Marking of *Halal*) 2011,
iv. The Food Act 1983,
v. The Regulation Food 1985,
vi. The Animal Act 1953 (Revised 2006),
vii. The Animals, 1962, the Order of Animals (Importation),
viii. The Abattoirs (Privatisation) Act 1993,
ix. State Syariah Criminal Offences Enactment and
x. The National Livestock Act

The current Malaysian Standard, MS 1500, "General Guidelines on the Production, Preparation, Handling, and Storage of *Halal* Food," which is a fundamental requirement for food products and food trade or business in Malaysia, prescribes the practical guidelines for the food industry regarding the preparation and handling of *Halal* food (Zakaria, 2008). Aside from that, food producers and manufacturers must adhere to the benchmark standards of Hazard Analysis Critical Control Point (HACCP), Good Manufacturing Practices (GMP), Good Hygienic Practice (GHP), and ISO9000 to achieve *Halal* requirements (Aziz & Chok, 2013). In certain ways, implementing food safety and cleanliness requirements assures that the food consumed is not only *Halal* but also safe. Other than that, the HDC, or *Halal* Development Corporation, is an entity wholly responsible for the administration of *Halal* and a sign of government initiatives put in place to strengthen Malaysia's position as a significant player in the global *Halal* market with good references by JAKIM's (Department of *Islamic* Development of Malaysia) on the management of *Halal* (Zakaria, 2008). HDC will also improve coordination, expedite the *Halal* certification procedures, and eliminate international complications to position Malaysia as a significant centre for *Halal* trade (Noordin, Md Noor, Hashim, & Samicho, 2009). Understanding *Halal* recognition, certification, and marketing-related components has determined the customer's purchasing intent for the product. According to Che Mohd Zulkifli (2013), the increased demand for *Halal* food, estimated

to be worth USD 346.7 billion or RM1317 billion annually, is associated with an increase in the number of *Muslim*s, a higher level of education, and greater purchasing power. Innovative food businesses have been surpassing the growing global market by establishing competitive advantages in the relevant market segments. Besides, the demand for *Halal* products is anticipated to rise because the world's population has topped two billion, and 57 nations have *Muslim* populations. Aside from this, *Halal* food sales in Malaysia account for RM36.63 billion, or 6.3% of nominal GDP (2009 prices), as Malaysian SMEs are now on par with the world's most influential businesses. Their products are widely available and considered high quality (Said, Hassan, Musa, & Rahman, 2014). On top of that, one of the most significant considerations in providing *Halal* food is to recognise that the *Islamic* dietary and consumption system is distinct from other ethnic groups. This is because the concept of *Halal* is not only related to food or food products but also goes beyond food to cover all aspects of *Muslim* life (Khan *et al.*, 2016).

Malaysia is among the nations whose government completely supports efforts to promote *Halal* certification for goods and services (Aziz & Chok, 2013). Malaysia aspires to be the global reference point for *Halal* integrity. The Malaysian government anticipates that by 2008, Malaysia will be the epicentre for the production and distribution of *Halal* products, *Halal* service providers, references to *Halal* standards, and *Halal* R&D. This is in line with the *Halal* Industry Mater Plan 2030, which is to strengthen the development of the *Halal* industry (HIMP 2030). The Malaysian government has also implemented a plan to make Malaysia the world leader in innovation, production, and trade in several *Halal*-related industries, including speciality processed foods, cosmetics and personal care, pharmaceutical ingredients, livestock, and the services sector, particularly logistics, tourism, and healthcare (Tsang, n.d). As a result, the *Halal* Hub Master Plan correctly identifies two development goals for Malaysia. Prioritise R&D and lead best practices in products, procedures, standards, and certification. Malaysia also possesses a well-rounded understanding of *Islamic* principles and other subjects, such as technological advancement, the sciences—particularly food, biochemistry, and microbiology—and business management (Said *et al.*, 2014).

4. Food colourant and its sources

Food is frequently coloured to improve its appearance and to boost sales (Spence, 2015). Despite the recent reduction in the permissible amount of synthetic colourants for consumer health reasons, a wide variety of synthetic food dyes are still used extensively around the world due to their low cost, high effectiveness, and excellent stability. Colourants are manufactured to boost their stability and appropriateness for various meals and beverages. Food is coloured for various reasons, including to restore colour lost during processing, to enhance colour that is already present, to reduce batch-to-batch variations, and to colour food that is otherwise uncoloured (Aberoumand, 2011). Consumers' avoidance of artificially coloured foods has encouraged the food sector to move to natural colours. According to Aberoumand (2011), food colourants can be categorised into natural, nature-identical, inorganic, and synthetic. Renewable resources are used to create natural food colourings. Natural colourants are derived from animals, plants, fruits, minerals, and spices. Most plant-based food colouring is sourced from fruits and vegetables and can be found in nearly every part of a plant, including the fruit, leaves, stalk, seeds, roots, and flowers (Rodriguez-Amaya, 2016).

Natural pigments such as carotenoids, myoglobin, chlorophyll, and anthocyanins may contribute to the natural colour (Khoo *et al.*, 2017). Carotenoids and anthocyanins are the two main classes of pigments responsible for the colouration of plants. Carotenoids are responsible for the orange and yellow lipid-soluble pigments in plastids, while anthocyanins are responsible for the pink, red, purple, and blue water-soluble vacuolar pigments in colourful plant pigments (Shrikant *et al.*, 2020). Annatto, paprika, saffron, caramel, chlorophyll, and turmeric are the most prevalent sources of carotenoids, followed by red pigment and caramels with a brown hue. Animal-derived food colouring is derived from insect bodily fluid. Cochineal, also known as carmine, is one of the most popular colours for animals. It is derived from the female cochineal insect. It is a native South American and Mexican insect that feeds on moisture and nutrients and inhabits the genus Opuntia of cacti (Dikshit & Tallapragada, 2018). The insect is dried and boiled to produce red food colouring. The body and eggs of the insect contain significant levels of carminic acid (Penang, 2015).

Mineral-based colourants include titanium oxide, calcium carbonate, iron oxide, and numerous others. Some of the most permanent and strong food colourings are made from mineral-based sources. Confectionery coatings, decorations, chocolates, calcium carbonate, bread, and gum are coloured with these substances (Rodriguez-Amaya, 2016). Natural colourants are typically extracted and concentrated using organic solvents for lipophilic pigments and water or lower alcohols for water-soluble pigments (Amchova *et al.*, 2015). The Muzakarah of the Fatwa Committee of the National Council for *Islamic* Religious Affairs Malaysia (1988) stated that cordial drinks containing added flavours which use alcohol as a stabiliser are permissible to drink and must comply with two conditions. Firstly, alcohol used as a stabiliser is not produced by making alcohol. Second, the quantity of alcohol in the flavours is a little, which is not intoxicating.

The law establishes limitations on the permissible colourants, the sources from which they may be derived, the solvents used to extract them, and the quality of the pigment. Nevertheless, several restrictions, including low resistance to heat, light, and pH, contribute to the limited usage of natural colouring. In addition to having a low tolerance for acidity and high temperatures, natural food colouring fades rapidly when exposed to light (Sezgin & Ayyilidz, 2017). Natural colouring is more expensive than artificial colouring, and natural colouring may impart an unwanted flavour (Sigurdson *et al.*, 2017).

Carotene, canthaxanthin, and riboflavin are some examples of synthetic pigments that closely resemble natural hues. The development of colour formulations has improved significantly over the past decades. Natural pigments originating from plant sources are unstable and sensitive to heat and pH, making them unsuitable for usage. As a result, in addition to stabilising them, researchers have formulated pigments identical to natural pigments (Dikshit and Tallapragada, 2018). These formulations emphasise the following criteria, as reported by Enaru *et al.* (2021). The first methods involve stabilisers, emulsifiers, and antioxidants to make them water-soluble. To improve the stability of pigments, oxidation is avoided. Efforts are being made to employ them in soft drinks, jellies, and other

products to increase their acidity. Work is underway to remove the allergens in natural pigments (peanut oil, maise, and soya derivatives).

Unlike natural colours, synthetic colours are created by humans (Aberoumand, 2011). These colours are created using chemical synthesis to resemble natural hues. Various synthetic dyes have been developed and used due to their lower production costs, longer shelf life, colour stability, and ease of blending to generate a vast array of hues (Sezgin & Ayyilidz, 2017). Tartrazine (E102), also known as an azo dye, is a petroleum-based artificial food colouring. In addition to producing the colour yellow, tartrazine can also be mixed with blue to create different hues of green. Tartrazine is present in bread, cereals, ice cream, soft drinks, confections, and canned goods (Silva *et al.*, 2022). Another often utilised azo dye is ponceau 4R (E124). It is made from petroleum and coal tar and is frequently found in processed meat, jams, jellies, drinks, and marmalades (Chung, 2016).

Based on their solubility, synthetic colourants are often classed as water-soluble or fat-soluble. Most fat-soluble synthetic dyes sold commercially are azo compounds such as Sudan I, Sudan II, Sudan III, and Sudan IV. Today, the Food and Drug Administration (FDA) in the United States permits two main kinds of food colourants: certified (typically synthetic colourants) and exempt from certification (typically natural pigments). However, there is no clear definition of what "natural" implies in this context (Sigurdson *et al.*, 2017). It has been determined that several azo dyes are harmful to the genetic system (Chung, 2016), and structure-activity relationships have been evaluated (Silva *et al.*, 2022). The worldwide food regulation act prohibits the use of Sudan I in foods. The International Agency for Research on Cancer has categorised Sudan (I-IV) as a category three human carcinogen (DiDonna *et al.*, 2004). However, imported food products such as paprika, chilli powder and curry pastes continued to contain Sudan dyes (Nisa *et al.*, 2016).

5. Food colouring issue

As a result of the expansion of the food industry, societies now have access to a vast array of food products, including staple foods, confections, desserts, and snacks. Due to time constraints and busy schedules, consumers now prefer processed or ready-made food to those they prepare. Unknown additives may be present in ready-made foods, which consumers may need to be aware of (Md Shariff *et al.*, 2021). Food and Drug Association (FDA) states that food additives are compounds added to food during production, processing, preparation, packaging, wrapping, transportation, preservation, and storage processes (FDA, 2011). Artificial colourings such as tartrazine, carmoisine, sunset yellow, ponceau 4R, quinoline yellow, and Allura are potentially hazardous to your health. There is evidence that safety concerns over artificial food colourings are developing.

The International Codex Alimentarius Commission (CAC), founded by the World Health Organization (WHO) and the Food and Agriculture Organization (FAO), defines food additives as "any substance not normally consumed as a food by itself and not normally used as a typical ingredient of the food, whether or not it has nutritive value, but added to achieve a specific purpose, known for having safe dose levels, and subject to regulation." Food colouring in Malaysia is governed by Food Additive Regulation in The Food Act 1983 and the Food Regulations 1985. Some synthetic dyes may be used as food colouring agents if they do not exceed the authorised threshold. It has been determined that the two principal dye groups, known as azo-dyes and triphenylmethanes, are most likely to be put into food without authorisation (EFSA, 2005). Azo dyes are organic compounds with numerous industrial applications. The metabolism of these dyes is responsible for their toxicity (Oplatowska & Christopher, 2015). Because they are easily applied, readily available, and stable in foods throughout processing, synthetic dyes are most frequently utilised in food-related applications (Munawar & Jamil, 2014).

Several health risks are associated with food colouring intake (Md Shariff *et al.*, 2021). Tartrazine, quinoline yellow, sunset yellow, carmoisine, azorubine, ponceau 4R, and Allura red are the six most common synthetic food colourants associated with attention deficit and hyperactivity in children. These substances can be found in sweetened foods and beverages (Martins *et al.*, 2016). Sunset yellow and tartrazine are widely mixed to create colour mixes for ice cream cones (Chung, 2016), while sunset yellow and carmoisine are used to create yoghurt (Pandey & Upadhyay, 2012). Meat and fish products typically contain carmoisine, erythrocin, tartrazine, Allura red, and red as colouring additives. These substances contribute to children's behavioural disorders, hyperactivity, and attention deficits; however, individual susceptibility varies considerably (Amchova *et al.*, 2015). There have been reports of tartrazine-induced allergic, including skin rashes, swelling, eye redness, and runny nose. Both sunset yellow and tartrazine have carcinogenic potential. Carmoisine has been linked to cancer, food poisoning, and allergic reactions. In addition, a study done in Japan found that cochineal might produce allergic reactions such as rashes, swelling, and itching. Research has also associated food colouring with health problems such as hyperactivity, allergies, learning disabilities, aggression, and irritability in children. Miller *et al.* (2022) also reported that the consumption of sunset yellow caused changes in children's behaviours.

Apart from behavioural concerns and cancer risks, the most evident risk that dyes provide to children is that they entice them away from nutrient-rich foods in favour of brightly coloured processed items that are high in calories but low in nutrients, such as fruit-flavoured drinks and snacks. According to CBS News (1990), these foods significantly contribute to the obesity epidemic sweeping the United States. Allura red is a synthetic colourant that may induce cancer, chromosomal aberration, developmental toxicity, DNA damage, genotoxicity, hyperactivity in children, neurotoxicity, phytotoxicity, and reproductive toxicity (Sabnis *et al.*, 2010). In addition to health concerns, the *Halal* status of food colouring may also be called into question. Cochineal (E120) is an example used in food, particularly in red velvet cake and crab sticks (McCann *et al.*, 2007). Besides locusts, Islam prohibits animals like caterpillars, ants, cockroaches, scorpions, mosquitoes, flies, bees, and spiders. According to a fatwa given by the State Mufti of Brunei in June 2015, cochineal is prohibited in food because the insect is regarded as impure or *najs* (Pelita Brunei, 2015). Even if only an extract or very small amounts of the insect are used to produce the colouring, it is still deemed haram because the colouring is still derived from the insect. Unlike liquid colours are designated as *Shubhah* (doubtful) since the solvent may be derived from haram sources unless it is *Halal*. However, Muzakarah Jawatankuasa Fatwa Majlis Kebangsaan Bagi Hal Ehwal Ugama Islam Malaysia and Majelis Ulama Indonesia have issued a fatwa on the consumption of cochineal

in food as permissible (JAKIM, 2015 and Majelis Ulama Indonesia, (2011). Fatwas in Malaysia are more inclined towards the opinion of the majority of Hanafi, Maliki and Hanbali jurists who categorise insect carcasses of insects that do not bleed as pure (Salleh *et al*., 2020).

6. Conclusion

In conclusion, the *Halal* food industry has gained much public interest due to a significant rise in consumer awareness regarding substances such as food colourants. The *Halal* standard of Malaysia also recognises food safety as an indicator of food quality and the status of *Toyyib*an. Therefore, it is essential to research food colourants derived from *Halal* and *Toyyib*an substances to identify new sources of pigments and improve food safety and quality assurance in the sector. Due to the increasing demand for pigment, separated natural colourants now outnumber synthetic colours in terms of demand.

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