A MINI REVIEW OF HEALTHY BARS – PURCHASING MOTIVES AND CHALLENGES: TOWARDS *HALALAN TOYYIBAN* APPROACH

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(Received: 10th. Jan. 2022, Accepted: 28th Jan. 2022, Published on-line: 31st Jan. 2022)

ABSTRACT: Nowadays, the consumption of healthy bars has increased worldwide due to the nutritional values and versatility of the products. The latest study explains these different healthy bars, their typical ingredients, and consumers' growing awareness on food safety and quality simultaneously demanding *halal*-certified products. This review article compares different healthy bars that influence consumers' purchasing motives and elaborates on the obstacles producers encounter while producing these healthy bars using *halal* and *toyyib*. The review was carried out by going through information from 98 publications related to four types of nutritious bars: (i) cereal-based bars, (ii) energy bars, (iii) fruit-based bars and (iv) vegetable-based bars. Meanwhile, the packaging attribute is the most crucial component influencing consumers' purchasing decisions. Manufacturers discovered the most challenging tasks are keeping up with the demand for unique ingredients in healthy bars and not forgetting consumers' demand for *halalan toyyiban* food products.

KEYWORDS: *Healthy bar; Purchasing motives; Challenges; Demand; Halalan toyyiban*

1. INTRODUCTION

Healthy bar, energy bar and cereal bar are the standard terms used other than food bar, which can be described as a small and light meal with critical nutritional values for human health and consumption. Bhakha et al. (2019) defined a healthy bar as a bar-shaped snack produced by pressing several ingredients such as cereals, dried fruits, nuts, and pulses together with glucose syrup. These extraordinary ingredients help provide additional essential nutrients such as carbohydrates, protein, and fibre, commonly obtained from the main meals. The word healthy describes that the bar is of good quality, safe, can provide health benefits and contains permissible ingredients for the Islamic dietary code. Most of the time, the production of the healthy bar consists of non-critical ingredients. However, there are several conditions the healthy bar can be considered non-halal or doubtful, particularly when it comes to imported products, (Riaz, 2007). For example, the usage of ingredients such as emulsifiers, enzymes, food additives derived from animal and unlawful sources, and liquor and alcohol, (Natalia et

al., 2019). Other than that, the production line of a healthy bar may come into contact or contaminate with unlawful substances. This is where *halal* labelling and appropriate food labelling on the packaging play a vital role to educate consumers on their choice of products, (Widya, Dennis & Sang-Ho, 2022). Consumers must be trained on the ingredient's selection as some imported products from the same manufacturers may contain different statuses on *halal*ness. Despite being a convenient and on-the-go snack, a healthy bar is packed in single packaging with 25 g to 30 g per serving, preferable by most consumers with hectic lifestyles as it can be consumed quickly within meals, (Silva et al., 2016).

The arrangement of the healthy bar within grocery stores has changed dramatically in recent years, moving from a niche section to a big cereal aisle that fills the shelves as much as the breakfast cereals. This indicates that demand increases exponentially, favourably boosting the global healthy bar market. Andrew (2018) reported the total market had reached $13.4 billion in 2017, and the sales are expected to increase 2.7% per annum for five consecutive years, to approximately $15.3 billion in 2022 globally. The primary target demographic for this healthy bar is athletes, but it has steadily grown to include a far broader range of people, including students and professionals, (Prazeres et al., 2017). In their writing, Curtain & Grafanuer (2019) explained that the vast groups of healthy bars consumers in Australia consist of 16% 4-13 years old children, 12.8% 14-18 years old teenagers, and less than 8% 19-50 years old adults. In addition, the younger consumers in North America and Japan have started to consume healthy bars in between meals due to their consciousness towards health and the health awareness campaigns by manufacturers, which is remarkably effective, (YUMMEX Middle East, 2019). Healthy bar producers have started manufacturing new formulations with unique ingredients, textures, and high nutrients to fulfil customers' requests from all around the world, thanks to a surge in health consciousness among consumers. For example, back in 2018, The Healthy Food Partnership in Australia has urged the reformulation of healthy bars by reducing 10% of the actual sugar content in healthy bars that contain more than 28 g of sugar by the end of 2022, (Curtain & Grafanuer, 2019). YUMMEX Middle East (2019) mentioned that another fascinating approach by healthy bar manufacturers worldwide is the production of low calorie and sodium and the addition of functional food such as vegetables, chickpeas, nuts, and legumes. Many recent articles focused solely on healthy bars' functional properties and digestion. As a result, the current review paper is comprehensive, to review different types of healthy bars and standard components utilised and factors influencing consumers' purchasing motivations and obstacles experienced by producers while making healthy bars with the approach to *halal and toyyib*.

2. MATERIALS AND METHODS

The first step to establish this study was the identification of keywords that were used for the selection of the research paper. The latest study elaborates on 'healthy bar', a general term used to describe different types available in the market. The most common topics discussed with healthy bars were nutritional value and preparation method. Thus, to encompass other obscure topics related to the healthy bar, several other keywords had been searched separately, such as 'purchasing motive', 'challenges', 'demand', and '*halalan toyyiban*'. After finalising the keywords, the next step was a selection of databases that were suitable for the study. The databases selected were based on the coverage of topics they offer, such as medical, science, technology, and social sciences, in peer-reviewed articles: academic journals, book chapters and conference proceedings. This included PubMed, ScienceDirect and Directory of Open Access Journal (DOAJ). During the initial search, approximately 150 documents were collected based on the study's keywords: i) healthy bar, ii) purchasing motives, iii) challenges, iv) demand, and v) *halalan toyyiban*. Next, the initial results were refined by excluding short

surveys and magazine articles. Based on the study's objectives, only scientific publications (articles and reviews) in peer-reviewed journals were considered, leading to 98 relevant articles published from 2000 until 2022. The remaining publications were discarded due to their out-of-date timeliness and lack of relevance to the study. After then, the articles were categorised into subtopics and stored in the same folder. The title, authors, published year, published journal and cited contents were extracted and collated for future use.

3. TYPES OF HEALTHY BARS

The rapid growth of healthy bars due to the promising health benefits toward consumers has increased market variability. There are three types of healthy bars: (a) health and wellness snack bars, (b) organic snack bars, as well as (c) energy bars and nutrition bars, (International Market Bureau Market Indicator, 2013). The nutrition bar can be divided into four subcategories: (i) cereal-based bar, (ii) energy bar, (iii) fruit-based bar, and (iv) vegetable-based bar. With the growing awareness regarding food safety and quality, the claim for *halal* certification for other food products increases, especially in cereal-based products, fruits, and vegetables, (Fortune Business Insight, 2020). Given this opportunity, most Malaysian producers have focused on obtaining *halal* certificates for their healthy bar products to target the overseas market since it is the most exported processed food in 2020, (Flanders Investment and Trade Malaysia, 2020). Constantin & Istrati (2018) stated that the cereal-based bar has good market adaptability due to its large number of nutrients and capacity to be blended with different ingredients for specific target groups, resulting in high consumer acceptance.

Meanwhile, athletes and physically active people use the energy bar as a dietary supplement to keep their calorie consumption in check, (Alla & Jithedran, 2018). Christmas et al. (2019) explained that a high carbohydrate, moderate protein, and energy bar offers vigour and vitality for long-term physical and mental activity. Consumers can typically get an adequate amount of essential vitamins and minerals by eating fruit-based bars with other ingredients like corn flakes, oats, and chocolate, (Nutrition Data, 2018). On the other hand, the current trend in the health bar market is the growth of vegetable-based bars, with various goods available on supermarket shelves, (Informa Markets, 2020). The report also mentioned that vegetables like lentils, chickpeas, and beans in flakes or powder manufacture healthy bars. These notable facts have proven that consumption of healthy bars can improve consumers' health, thus governing the *toyyib* aspect. According to Idris Oyewale and Asnidar Hanim (2018), Muslim consumers had deemed *halalan toyyiban* food products to represent hygiene, safety, and quality. Studies suggested that halal and toyyib food products can improve spiritual and physical well-being by boosting the human body energy, esteem level, and mood, (Shahida, Amena & Muhammad, 2021).

3.1 Cereal-based Bar

A cereal bar is made up by compressing several kinds of cereals' mixture such as oat, cornflake and puffed rice with additional ingredients such as dried fruits and 'glued' together by binding agents, commonly glucose syrup or honey, (Sharma et al., 2014). As a good nutrient delivering the vehicle, the cereal bar has become consumers' first choice to substitute less-healthy snacks, replace meals, or pre-workout quick energy sources, (Aleksejava, Sikna & Rinkule, 2017). The mentioned research explained that preparing cereal bars can be divided into two types: cold process and hot or oven process. In the cold method, the cereal bar ingredients will be mixed and moulded, refrigerated, or left at cool temperature (room temperature) compared to the hot or oven method, which mixes the dried ingredients with agglutinants before being baked, (Constantin & Istrati, 2018). In their research, Ravindra &

Sunil (2018) prepared the cereal bar using a cold method in which it had been left at room temperature after being moulded.

Meanwhile, Eke-Ejiofor & Okoye (2018) stated that the temperature and time commonly used to bake the cereal bar are at 140℃ for 40 minutes, respectively. However, a few researchers combined both methods (cold process and hot or oven process) in cereal bars due to the ingredients' suitability. Su-ah, Ahmed & Jong-Bang (2017) baked the cereal bar first at 80℃ for 1 minute and 30 seconds, then transferred it into a baking tray and left it at room temperature for 1-hour before storage. The vital part of a cereal bar lies in its nutritional composition in which, according to the European Consumer Health and Consumers Directorate-General (2012), the amount of carbohydrate, protein, and fat in a healthy bar of 100 g should be between 10 g to 40 g. Silva et al. (2016) obtained a tolerance range of carbohydrate, protein, fat and energy in the production of the cereal bars, which were 36.64 g to 41.4 g, 21.28 g to 23.96 g, 23.27 g to 29.38 g, respectively. In addition, Nirmala Prasadi & Iris (2020) elucidated the cereal bars that contained a range of 8.97 g to 9.16 g fibre can be considered as rich in fibre product following European Parliament and the Council Regulation (2006, No. 1924/2006), if a product of 100 g contains at least 3 g of fibre, the product can be considered containing a source of fibre. If a product of 100 g contains at least 6 g of fibre, it can be considered rich in fibre.

The next part of the review paper will review the common cereals used in the production of cereal bars and their condition in the production and respective roles in providing benefits to consumers' health, as in Table 1 below:

Table 1: Common cereals in cereal bar production, conditions, and health benefits.

Cereals	Condition and Health Benefits	Reference
Oats	**Condition: flakes** *Health Benefits: Reduce Bodyweight* Oats help reduce body weight, mainly in overweight people, due to the presence of soluble oat fibre, Oat Beta-Glucan (OBG), which can subdue appetite, enhance satiety, and minimise energy intake afterwards. The viscous properties of OBG slow down gastric juice emptying and delay the absorption of macronutrients, thus increasing gastric juice's interaction with intestinal cells to secrete satiety hormones promptly inhibit the release of peptides responsible for stimulating appetite regulation. *Health Benefits: Increase Antioxidant Defence Mechanism* OBG can also increase antioxidant defence mechanisms and reduce lipid peroxidation. OBG enhances the activity of superoxide dismutase, one of the antioxidant proteins in human cells, catalyses the dismutation of superoxide radicals that cause damage to cells into ordinary oxygen and hydrogen peroxide molecules. These can help stabilise free or unstable radicals in consumers' bodies upon consuming oatmeal products.	(Paudel et al., 2021) and (Martınez-Villaluenga & Penas, 2017)

	Health Benefits: Reduce the Risks for Cardiovascular Diseases Consumption of oatmeal products for an extended period can reduce about 3% to 10% low-density lipoprotein (LDL) cholesterol and eventually triglycerides, subsequently reducing a range of 6% to 18% coronary heart disease risk. LDL causes the build-up of fatty deposits within arteries, later reducing or blocking blood and oxygen flow needed by the heart leading to a heart attack.	
Corn	**Condition: flakes** *Health Benefits: Improve Weight Control* Consumption of cornmeal products can enhance the reduction of food intake as corn contains resistant starch (RS), a dietary fibre that dilutes energy density which promotes satiety or the feeling of fullness. *Health Benefits: Improve Intestinal Digestive Tract* RS helps to enhance faecal removal and reduce diarrhoea symptoms by altering microbial populations through the fermentation of short-chain fatty acid in the large intestine. *Health Benefits: Good Source of Vitamin* Corn contains an abundance of B-complex vitamins, good for skin, heart, brain, and digestion. It can also reduce rheumatism symptoms, a disease marked by inflammation and pain in the muscles and joints due to improving joint mobility.	(Smith, 2018) and (Shah, Prasad & Kumar, 2016)
Puffed rice	**Condition: flakes and powder** *Health Benefits: Improve Satiety and Weight Loss* Puffed rice has remarkably low bulk density compared to cooked rice, and thus the consumers will reach early satiety preventing them from consuming food further. The production of puffed rice does not involve any external oil, which can inhibit calorie addition upon its consumption, especially for dieting consumers. *Health Benefits: Improve Bowel Movement* The production of puffed rice modifies starch which leads to resistant starch, a good source of prebiotic to enhance the growth and proliferation of good microbial in the intestine resulting in the improvement of intestinal health and bowel movement.	(Saha & Roy, 2020)

3.2 Energy Bar

The energy bar is frequently consumed by athletes and consumers who practice active lifestyles due to the enormous amount of nutrients, (Aljaloud, Colleran & Ibrahim, 2020). The current trend of incorporating high-protein ingredients in energy bars to help muscle tissue growth has become extremely popular, (Malecki et al., 2020). The high-protein energy bar has the highest protein content level compared to other bars, (Rajabi, 2017). Athletes and physically active consumers should consume enough carbohydrates before conducting exercises, and post exercises as a human body might lose about 1 to 2 L of fluid per hour which is equivalent to 40 mEq/L to 80 mEq/L sodium loss and 80 mEq/L to 160 mEq/L loss of total electrolytes during exercises, (Bonilla et al., 2021). This is because carbohydrates can enhance fluid retention in human bodies through a reasonable mechanism, (Murray & Rosenbloom, 2018). The mentioned research explained that ingestion of energy bars or beverages that contain high carbohydrates after exercises could kindle greater retention of intracellular fluid associated with glycogen storage as the glucose transported into cells raws out water along with the substrate, and glycogen promptly increases total body water. Carbohydrate also offers energy for muscular activity in one hour of vigorous endurance training, (Pearson, 2017). The importance of protein consumption, especially for bodybuilder athletes, is to build up cells and repair damaged tissue, (World Health Technical Report Series 935, 2007). Common ingredients in the production of high-protein energy bars are banana, date, and whey protein. The most common method in preparing an energy bar is the cold process. The cold-processed bar is the extruded bar, often coated with chocolate, (US Dairy Export Council, 2007). Ho et al. (2016) assembled the energy bar using the cold method in which the final products were allowed to cool in the refrigerator for 1-hour before conducting analyses.

Meanwhile, Alla & Jithendran (2018) explained that the energy bar should be allowed to freeze at -15℃ for 5 minutes to 10 minutes for proper binding. European Commissions Directorate-General for Health and Food Safety (2015) suggested that the composition of carbohydrate, protein, fat and fibre in the energy bar should be 70.90 g, 10.50 g, 3.60 g and 1.45 g, respectively for each 100 g of the bar. The nutritional composition of the energy bar produced by Silva et al. (2016) is highly acceptable in which carbohydrate, protein, fat and fibre contents indicate 77.27 g, 6.77 g, 1.96 g and 3.23 g for each 100 g of the energy bar, respectively. Meanwhile, the nutrient compositions of the high-protein energy bar suggested were 26.70 g for protein, 61.60 g for carbohydrate, 0.60 g and 0.50 g for fat and fibre, respectively. Research conducted by Jabeen, Huma & Sameen (2020) obtained a similar result as suggested above, which were 22.38 g of protein and 0.32 g of fat. However, the carbohydrate and fibre contents were not mentioned in the research.

The common ingredients used in the production of the high-protein energy bar, their conditions and health benefits will be discussed further in Table 2 as follows:

Table 2: Common ingredients in the energy bar production, conditions, and health benefits.

Common Ingredients	Condition and Health Benefits	Reference
Banana	**Condition: powder and puree** *Health Benefits: Good Source of Energy* Banana is a good source of energy as it contains high carbohydrates consisting of reducing sugar, mainly glucose and fructose, which are readily absorbed in the	(Sale & Elliot-Sale 2019) and (Ho et al. 2016)

	blood after digestion to increase blood sugar level, providing the energy required by the human body. *Health Benefits: Improve Bowel Movement* Banana has an abundance of non-digestible fibre, including cellulose, hemicellulose, and α-glucan, which can help restore regular bowel activity, constipation, and diarrhoea. Insoluble fibre can increase the stool size and weight, causing it to pass through the bowel easily; meanwhile, the digestible fibre increases the water absorption in the intestinal tract, thus normalising the colon's function for better bowel movement. *Health Benefits: Improve Muscles and Bones Health* The consumption of bananas can benefit athletes as bananas contain calcium, good for bone health, and potassium, essential in maintaining proper muscle working and preventing muscle spasms. Vitamin A, which aids in healthy bones and teeth, vitamin B, which increases the human immune system and promotes brain health, vitamin C, which aids in the growth of tissue lining and vitamin D, helps the body absorb calcium efficiently.	
Date	**Condition: powder, puree** *Health Benefits: Good Source of Energy* The date is a good source of energy as its principal constituent is carbohydrate ranging from 55 g to 80 g for each 100 g of date consumed, providing 12% to 15% energy in adults. This can be explained by the high amount of reducing sugar in date, mainly glucose and fructose, elevating the blood sugar level massively as they are readily absorbed upon digestion, supplying more energy to the human body. *Health Benefits: Increase Satiety and Feeling of Fulness* A date has a high amount of dietary fibre, mainly insoluble fibre, which can cause satiety, a state in which further eating is inhibited. The chewing process of food rich in dietary fibre takes more time and effort, which increases the oral exposure towards saliva resulting in the expansion of the stomach, which directs the signal to the brain and mediates satiety sensation. *Health Benefits: Improve Colon Health* Prebiotic in date can stimulate the growth of beneficial bacteria such as lactobacilli. The change in the growth of lactobacilli increases colon health by inhibiting pathogens (Bacteroides) growth and increasing the production of	(Hinkaew et al., 2021) and (Alalwan et al., 2020)

	acetate and lactate. Besides, the inhibition of Bacteroides might as well be contributed by the presence of polyphenols in date, which can bind to bacterial cell membranes, inhibiting their growth.	
Whey-protein	**Condition: powder** *Health Benefits: Improve Bone Health* Whey protein contains essential milk protein, improving bone formation and preventing bone resorption. This can be elucidated by the ability of whey protein to activate osteoblasts, cells responsible for new bone formation. *Health Benefits: Improve Physical Performance* The critical feature of whey protein is mainly branched-chain amino acids (BCAAs) which can be metabolised directly into muscle tissue. This benefits especially the athletes as it can quickly repair and rebuild lean muscle tissue, which decreases during exercises and resistance training. These amino acids provide energy during endurance training, allowing athletes to train more intensively for an extended period.	(Minj & Anand, 2020), (Kadam et al., 2017), and (Alimoradi et al., 2016)

3.3 Fruit-based Bar

Fruit bar has existed vastly in the industry for many years. This is one of the methods to preserve fruits in confectionery products. Most fruits' nutrients, minerals, and flavour profiles are held in the pulp, the main fruits commonly used in producing fruit bars, (Czech et al., 2020). The massive difference in the production of fruit bars from cereal and energy bars is the drying process of the fruit itself. There are several methods to dry fruits before fruit bars, (Calin-Sanchez et al., 2020). The same study explained that the conventional drying technique using high temperature and a long drying period could affect the final food product's colour, flavour nutrient contents and weight and rehydration capacity of the dried fruit. Hence, modern technology approaches in drying fruit techniques have been developed, including vacuum drying, infrared drying (Tiwari, 2019) and freeze-drying, (Oyinloye & Yoon, 2020). Vacuum drying is ideal for drying thermal or oxygen-sensitive food such as fruits and vegetables as it can inhibit oxidation, colour, and flavour reduction of the dried products due to the absence of air, (Raquel, 2018). This involves placing the object dried in an enclosed container to vent air and reduce pressure using a vacuum pump to increase the vaporisation of water molecules inside the object due to the low pressure, (Sadat Kamal et al., 2017). Demarchi, Irigoyen & Giner (2018) explained that the possibility of developing a fruit bar rich in vitamins is high as the fruits are treated with a vacuum drying method.

Meanwhile, through infrared drying, the dried food sample will have a firm texture, minimal colour and nutrient loss as infrared power increases the rate of drying of the food sample, simultaneously reducing the exposure of the food sample toward oxygen, (Sakare et al., 2020). According to the same study, infrared radiation of 0.78 to 1000 nm wavelengths transfers thermal energy as electromagnetic waves, producing heat on the surface of food material and being transferred to the inner part through conduction. Different situations can be observed in the freeze-drying method. It can preserve the food sample quality due to low

processing temperature, the absence of oxygen during processing, and limited mobility of frozen water at the surface, causing structural rigidity, thus minimising degradation reactions, (Oyinloye & Yoon, 2020). According to the United States Department of Agriculture (1991), consumers will obtain 78.50 g carbohydrate, 1.80 g protein, 5.30 g fat and 0.80 g fibre upon consumption of 100 g fruit bar. Meanwhile, a 100 g fruit bar contains remarkable mineral compositions such as 29 mg calcium, 55 mg phosphorus, 77 mg sodium, 0.043 mg thiamine and 0.300 mg riboflavin, (USDA, 1991).

Table 3 below will issue the common fruits used in fruit bar production, their condition and respective health benefits toward consumers health:

Table 3: Common fruits in the production of fruit bars, their conditions and health benefits.

Fruits	Condition and Health Benefits	Reference
Blueberries	**Condition: dried fruit** *Health Benefits: Improve Cognitive Function* Research conducted agreed that the intervention of blueberries after two and six hours in young and healthy children, aged seven to ten years old, boosted the episodic memory and increased their focus in tasks that required cognitive elements such as delaying recall and recognition, sustaining and dividing attention. *Health Benefits: Neuroprotective and Senescence Inhibition* Blueberries have the ability to inhibit the aggregation of amyloid-beta (αβ) peptides into fibrillar amyloid plaques. The plaques activate Microglial pro-inflammatory causing neuronal and synaptic damage contributing to cognitive impairment. This is because blueberries can prevent the aggregation of αβ and suppress Microglial activation due to flavonoids such as catechin, epicatechin and anthocyanins, thus improving neuronal signalling and increasing memory function, slowing down the rate of dementia. *Health Benefits: Good Source of Prebiotic* Due to high polyphenol and fibre content, blueberries are able to induce the proliferation of probiotics subsequently improve gut health by eliminating pathogens in the intestine.	(Silva et al., 2020) and (Kalt et al., 2019)
Mango	**Condition: puree and dried fruit** *Health Benefits: Good Source of Antioxidant* The abundance of phytonutrients such as polyphenol and ascorbic acid can be obtained from any part of mangoes, especially in the exocarp, mesocarp and endocarp. These phytonutrients can effectively stabilise oxidative damage by hydrogen or electron donation by	(Bajpai, 2020) and (Lauricella et al., 2017)

	reactive oxygen species (ROS). The elimination of ROS is vital as they can counteract the cellular repairing abilities of cells which causes cells function to deteriorate, resulting in the development of diseases such as ageing, heart attack and diabetes. *Health Benefits: Good Source of Anti-inflammatory Effect* Other than that, the polyphenols in mango extract reduce the inflammatory effect caused by the induced dextran sodium sulphate that can lead to extreme activation of mTOR, promoting inflammation. The anti-inflammatory effect of mangoes is directly contributed by the presence of polyphenols and flavonoids, which reduce the level of iNOS, COX-2 and *TNF-α* proteins that induce inflammation. Besides, these polyphenols and flavonoids can scavenge free radicals (metal ions) due to their lower redox potentials that can chelate metal ions, thus protecting membrane structure and functions.	
Jackfruit	**Condition: dried fruit** *Health Benefits: Good Source of Vitamins and Minerals* Many research had listed abundance vitamins and minerals contents of jackfruits including vitamin B-complex, mainly, vitamin B_6 (pyridoxine), vitamin B_3 (niacin), vitamin B_2 (riboflavin), vitamin B_9 (folic acid) as well as potassium, calcium and magnesium. However, the one that should be highlighted is its excellent vitamin C content, as it cannot be produced naturally by the human body. Given its promising vitamin C content, jackfruit consumption will surely improve human skin health, which is commonly caused by prolonged exposure to ultraviolet (UV) radiation, consequently generating adverse effects on human skin, including skin cancer and prematurely ageing skin. Vitamin C can secrete collagen, a protein that gives structure and strength to the skin and acts as an antioxidant that protects skin cells from free radicals. *Health Benefits: Good Source of Antioxidants* Jackfruit contains a substantial amount of carotenoids, an antioxidant that can reduce the risk of cardiovascular diseases such as coronary heart disease, heart attack and heart failure. Cardiovascular diseases occur due to elevated low-density-lipoprotein (LDL), the 'bad cholesterol'. The oxidation of LDL is thought to release excess free unstable radicals, which contribute to atherosclerosis that modify arterial wall and promote	(Ranasinghe, Maduwanthi & Marapana, 2019)

	tissue injury and protein oxidation. Luckily, antioxidants (carotenoid) can retard the oxidation process, simultaneously protecting the heart by neutralising excessive free radicals. *Health Benefits: Improve Digestive System* Previous studies reported dietary fibre in jackfruit was a good bulk laxative that was undigestible but absorbed liquid in the intestine and swollen, producing a soft and bulky stool. Accordingly, the laxative reduced contact time to carcinogenic substances, discarding the substances from the large intestine and spontaneously protecting the colon mucous membrane.	

3.4 Vegetable-based Bar

The current market trend of the health bar is slowly shifting from healthy, convenient, and on-the-go products to the health bar with additional bioactive compounds or functional food such as lentils, pulses and beans, (Olatunde et al., 2019). Adding these protein-complement ingredients may improve fibre and bioactive contents in the products, (Herawati et al., 2019). The most frequent methods used in vegetable bar development are extrusion-cooking and baking, (Silva et al., 2016; Skarma et al., 2020). Extrusion-cooking is the process of mixing, conditioning and transforming ingredients into melt fluid resulting in degradation of functional compounds due to changes in structure and chemicals controlled by several factors such as temperature, moisture content and screw speed, (Ruiz-Gutierrez, Sanchez-Madrigal & Quintero-Ramos, 2018). It involved a single-screw cooking extruder suitable for processing expanded snacks, breakfast cereals and puddings, while a twin-screw cooking extruder is commonly used to produce chocolate coatings, candies and gums, (Tiwari, 2019). A food extruder is a bioreactor that uses high-temperature short-time (HTST) to transform raw ingredients into finished products. This characteristic is advantageous in processing products made from thermal sensitive ingredients such as soy and legumes with high protein content, (Quintero, Rojas & Ciro, 2018). As for the baking method, the preparation of the vegetable bar started with the mixing of dry ingredients and agglutination syrup, commonly honey and glucose sugar, before baking at 130℃ for 15 minutes, (Lucas et al., 2019). The nutritional composition of the vegetable bar varies according to the type of ingredients and formulations used. Ramirez-Jimenez et al. (2017) reported that the nutrient contents of healthy bar added with common beans were 12.63 g protein, 14.91 g fat, 61.65 g carbohydrate and 22.04 g fibre at the highest level of common bean incorporation for each 100 g bar.

Table 4 below will discuss the common vegetables used in the production of vegetable bars, their condition, and health benefits:

Table 4: Common vegetables in the production of vegetable bars, their conditions and health benefits.

Vegetables	Condition and Health Benefits	Reference
Lentil	**Condition: flakes and powder** *Health Benefits: Improve Cardiovascular Health*	(Nathan et al., 2020) and

	Lentils contain a tremendous amount of folate, which can reduce the extension of hyperhomocysteinemia, usually caused by a deficiency of folate. Hyperhomocysteinemia is high homocysteine (an amino acid) that can cause arterial damage and blood clots in blood vessels. *Health Benefits: Anti-diabetic Properties* The dietary fibre and carbohydrates in lentils contribute to anti-diabetic characteristics in which they inhibit impairment in the metabolic control of patients with Type-II diabetes. Lentils significantly reduce blood glucose due to their low glycemic index (GI) value by suppressing glucose metabolism. Too much glucose may affect pancreas β-cells, thus reducing protein and enzyme for glycosylation of the metabolic process. *Health Benefits: Control Body Weight* Consumption of pulses such as lentils has an inversely proportional relationship with body mass index (BMI), which means the high consumption of lentils reduces BMI. This is because lentils contain high fibre with low GI value, leading to satiety and reducing food intake. Satiety is caused by expanding the absorbed fibre in the intestine, enhancing satiety thus controlling body weight.	(Ganesan & Xu, 2017)
Soybean	**Condition: flakes and powder** *Health Benefits: Improve Heart Health* Soybean is a good source of isoflavones, an antioxidant that can lower low-density lipoprotein (LDL) upon consumption. Oxidation of LDL particles will cause lipid peroxidation and harm apolipoprotein b100, an LDL protein that moves cholesterol around the human body. The scavenger receptor will detect the oxidised LDL located within the arterial wall, and the uptake of oxidised LDL by the scavenger receptor can cause massive regulation of LDL cholesterol, leading to plaque formation in the heart. Thus, the isoflavones in soybeans can prevent LDL oxidation due to the hydroxylated diphenol structure. *Health Benefits: Improve Bone Health* Soybean isoflavones inhibit rapid osteoclast activity and bone resorption and increase bone density, leading to the prevention of osteoporosis. Osteoporosis is a disease in which bone density and calcium content gradually decreases due to osteoclast's overactivity, leading to an increased rate of pelvic fracture, especially in the	(Garima et al., 2020) and (Saha & Mandal, 2019)

	elderly. It is suggested that the consumption of 40 g of soybeans containing 90 mg of isoflavones for six consecutive months can help promote bone health.	
Spinach	**Condition: powder** *Health Benefits: Improve Digestive Tract* Spinach is a good source of fibre in which it can be fermented to hydrogen and carbon dioxide by colonic microflora, allowing it to bind water while passing through the large intestine resulting in the increasing of stool weight redirecting to ease constipation. Besides, spinach consumption can nurture the digestive tract by removing accumulated waste. *Health Benefits: Reduce Arterial Stiffness* Spinach possesses the highest dietary nitrate compared to other vegetables. The dietary nitrate may produce nitric oxide through an anaerobic reaction, an alternative to the oxygen-dependent L-arginine endothelial. The supply of nitric oxide is substantial in preventing the physiopathology of cardiovascular disease resulting in arterial stiffness due to limited blood and oxygen supply. *Health Benefits: Improve Eyes Health* Spinach is rich in Vitamin A, which promotes eye health by reducing the risk of macular degeneration and vision loss, resulting in night blindness. Besides, Vitamin A in spinach can boost the immune system and help to soothe eyes inflammation.	(Afra & Seied, 2019)

4. FACTORS INFLUENCING CONSUMERS' MOTIVATIONS IN PURCHASING HEALTHY BAR

The package attribute is the number one feature that leads to purchasing reasons for healthy bars, (Pinto et al., 2017). The same study also mentioned packaging of a healthy bar is an important marketing tool that visually represents the brand and promotes healthy ingredients and added value. Healthy bar packaging must fulfil the objective to provide valuable information related to nutrient contents of the product to capture consumers' attention as nowadays they are focusing on products that benefit their health to match their daily activities, (Chili, 2017). Meanwhile, Pinto et al. (2019) added that attractive packaging could convey information, recognise the brand, and preserve the product from damage. Packaging can be a good tool of communication that provides essential information regarding the ingredients of the product, which consumers can view before purchasing. Consumers are becoming more attracted to consuming products with diminished sodium and high in omega 3, (Sarika et al., 2019). New rules adopted by hospitals and public institutions promoting healthier food and

environmental concern have increased consumer health awareness, (World Health Organization, 2015). These factors indicated the second factor influencing consumers' intentions to buy healthy bars. Consumers anticipate a low-calorie, low-sugar, low-salt bar containing whole grains, fruits, oats, pulses, and beans and are free of artificial colour and flavour, (Salam et al., 2021). Price, taste, and flavour are among the elements that influence consumers' decision to buy a healthy bar, (Pinto et al., 2019). Price manipulation plays a crucial role in healthy bar consumption, quoting from the Australians experience stating that price is one of the considerations they consider when buying food and beverages, (Forbes, Kahiya & Balderstone, 2015). The increased price reduced the consumption of unhealthy snacks, as concluded by Schlinkert et al. (2020), thus approving the effectiveness of price manipulation in promoting healthy snacking. Healthy bars with a reasonable price and rich in nutrients will surely attract consumers who practically include healthy bars in their daily meals. Other than that, the taste attribute is a powerful element influencing a healthy bar's purchase intention, particularly among older consumers, (Kuster-Boluda & Vidal-Capilla, 2017). Consumers use their five senses in determining the palatability of products in which taste is one of them. Pinto et al. (2017) explained that the 'being tasty' attribute is an essential factor that influences consumers' purchasing intention other than 'ready-to-eat' and 'on-the-go'. Despite all the reasons mentioned above, Muslim consumers also highlighted *halal* and *toyyib* as driving factors upon consuming healthy bars. Halal food selection is one's responsibility in obeying religious obligations, (Ruslan, Kamarulzaman & Sanny, 2018). Islam accentuates food consumption by Muslims is to achieve an evocative life which shows the importance of choosing *halal* and *toyyib* food products. Widya, Dennis & Sang-Ho, (2022) demonstrated that appropriate and pinpoint food labelling, including the *halal* logo on the healthy bar packaging, influenced consumers purchasing motives. *Halal* logo is recognised internationally and assure consumers that the products are *halal* and safe to be consumed, governing the *toyyib* aspect, (Muhamad and Abdul Latiff, 2017). Mature consumers acknowledge the imported brands of healthy bars thanks to the *halal* labelling on the packaging, giving confidence upon consuming them, (Hasnat et al., 2017). Healthy bars with *halal* labelling may lead to an easy sale in Malaysia's market and food sectors resulting in a win-win situation for consumers and manufacturers. For Muslims, the behaviour of consuming *halal* labelled products was due to their religious background and closely related to religious teaching and own interpretation, which developed their food habits, (Muhamad & Abdul Latiff, 2017). Having easy access to *halal* food, especially in Malaysia, consumers showed a positive attitude and perceived behavioural control over their motives for choosing it, (Shahida, Amena & Muhammad, 2021). The same study also mentioned that Muslims with high positive attitudes appeared to have greater intention to consume halal labelled healthy bars. Meanwhile, Muhamad & Abdul Latiff (2017) elucidated that intention to purchase healthy bars is strongly related to perceived behavioural control by consumers. Kim-Soon et al. (2018) suggested that healthy bar manufacturers in the future can develop new products which are more versatile that can be consumed on broader occasions, not just simply for breakfast and between meals, as well as a more sophisticated healthy bar for lunch which contains all elements (low-calorie, low-fat, low-sodium and high-protein) together. Manufacturers of food technologists of the healthy bar need to cater to consumers' ever-changing needs to preserve the continuous growth of the health bar market.

5. CHALLENGES FACED BY MANUFACTURERS IN PRODUCING HEALTHY BAR

Meanwhile, the main issue for healthy bar manufacturers is keeping up with continually changing consumer demands for organic ingredients, fresh vegetables, and fruit in the healthy bars they consume, (Santeramo et al., 2018), especially given Malaysians' growing concern for *halalan toyyiban* food sources. As the demand for *halalan toyyiban* food products is growing day by day, manufacturers face pressure to comply with requirements for *halal* certification issued by the Department of Islamic Development Malaysia (JAKIM). However, *halal* accreditation is more than just a religious requirement, and it is a powerful marketing tool to assure the products they produce are halal compliant, safe and of good quality to be consumed, (Hosen & Lathifah, 2018). Likewise, intertwining the *halal* and *toyyib* aspects is another challenging task. *Halal* means permissible and lawful (Afiqah et al., 2017) and *toyyib* reflects the features of *halal* in which food should be wholesome, have good quality and be safe for consumers, (Nafis, 2019). Healthy bar producers need to keep updated on the current issues related to *halal* as there is a growing need for healthy bars from *halal* and *toyyib* ingredients, especially in Malaysia, (Muhamad & Abdul Latiff, 2017).

Regarding these aspects, healthy bar manufacturers should always keep track and ensure the sources or raw materials and whole processes involved comply with the one guided by JAKIM. They must tackle controversial issues such as genetically modified food only using raw ingredients from *halal* and *toyyib* sources. Meeting these requirements mean that manufacturers are bound to provide continuous supply over their products in the broadest range of innovation such as flavour, nutrient content, and taste, (Azanedo et al., 2020). Not only that, but innovation has fueled competition among manufacturers, forcing them to create products with added value, such as appealing food packaging, improved shelf life and reduced waste, as well as new alternative ingredients that boost the nutrient content of products, to keep their products relevant over time, (Jeong & Shin, 2020). As a result, the manufacturing costs of a healthy bar will climb, particularly in small and medium-sized businesses, as they will be forced to follow the present market trend since most of the production expenses are spent on recipe creation and processing, (Pinna et al., 2018). However, this challenge or difficulty can be reduced by using local or seasonal rather than imported ingredients to save the cost of ingredients, (Lancet Planet Health, 2017). The use of local or seasonal ingredients helps develop new healthy bar flavours, increasing the market demand for those products, (Tores-Leon et al., 2018). Another issue manufacturers confront when embracing new laws and regulations relating to healthy bars is environmental preservation. Excessive fertiliser use may harm the environment and ingredients added to the healthy bar, adversely affecting consumers' health upon consumption, (Sadiku, Musa & Ashaolu, 2019). Given the task to be innovative, manufacturers need to ensure the ingredients used for healthy bars production are green and safe upon consumption. Apart from that, new legislation was introduced by Denmark in which manufacturers will be issuing taxes on the saturated fats used in their products as an initiative to the new price policies introduced by World Health Organization to promote healthier diets, (World Health Organization, 2015). Besides creating new healthy bar formulations, manufacturers are also bound to follow the new legislation to gain benefits rather than loss paying fines. These challenges must be tackled by healthy bar manufacturers to preserve their products in the market and ensure the sustainability of the products for an extended period.

6. CONCLUSION

Healthy bars have been popular for decades, and the industry will continue to grow as new formulations and improvements in healthy bar manufacturing emerge. The same goes for *halal* and *toyyib* healthy bar production since the Muslim populations tend to expand, increasing market expansion opportunities. The primary goal of summarising the research in this field is to understand the different types of healthy bars better, the factors that influence consumers' purchasing motivations, and the obstacles manufacturers confront in developing healthy bars such that everyone benefits. Consumers who are just starting to consume a healthy bar will be educated on permissible ingredients to select according to Islamic jurisprudence for the different types available to match their needs. In contrast, healthy bar makers will enhance their products by recognising consumers' intent to buy and address industry-wide difficulties. Manufacturers are working on new healthy bar formulas responding to consumer demand, continually shifting based on current preferences and awareness, simultaneously adjusting to produce *halal* and *toyyib* healthy bars. As many novel healthy bar formulas are produced, research on the health advantages of the healthy bar is still in its early stages. Not only that, the critical ingredients and processing line used to produce a healthy bar that meets *halal* and *toyyib* aspects should be carved more profound, as indicated by relatively low publications on the topic. More research is needed, including healthy bar intervention in diets, and clinical trials are required to assess the possible health advantages of a healthy bar that have yet to be discovered.

ACKNOWLEDGEMENT

The authors would like to express their appreciation for the grant support from the Ministry of Education with Ministry Project ID: RACER/1/2019/STG03/UIAM/1.

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