

CONSUMER ACCEPTANCE OF NUTRITIONAL DATES SEED INNOVATION FOR A NEW ICE CREAM FLAVOR IN MALAYSIA

Razmah Mahmud^{1*}, Mazni Saad², Faizah Mashahadi³, Nazura Mohd Sayuti⁴

¹Faculty of Business and Management, UiTM, Kampus Puncak Alam, Malaysia

Email: razmah@uitm.edu.my

²Kuliyah of Languages and Management, IIUM, Pagoh Campus, Malaysia

Email: maznisaad@iium.edu.my

³Faculty of Business and Management, UiTM, Kampus Puncak Alam, Malaysia

Email: faizah@uitm.edu.my

⁴Faculty of Business and Management, UiTM, Kampus Puncak Alam, Malaysia

Email: nazura@uitm.edu.my

*Corresponding Author

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Abstract: *Date fruit is a type of fruit grown mainly in the eastern region. Favourable research findings on date nutritional value have led to dates becoming one of the well-known fruits consumed by many people worldwide. In general, people only consume the date flesh but throw the seed as waste. Recent studies have indicated nutritional benefits in date seed with potential health benefits for human beings. In relation to promoting a green environment, this study examines consumer acceptance of the innovation of nutritional dates seed powder as the main ingredient in producing a new ice-cream flavour in Malaysia and determines the dates' nutrient content seed ice-cream mixture. The survey questions were adapted from the Nielsen Global New Product Innovation Survey, Q1 2015, distributed through the Google form application. Of the 301 respondents randomly chosen, 94% agreed that dates seed ice cream was an innovative food with nutritional value. In contrast, 84.7% were interested in buying the ice cream if it was available in the market. The descriptive analysis indicated that the respondents accepted dates seed ice cream as a new ice-cream flavour with nutritional benefits. In determining the nutrient content of the seeds of the dates in the ice cream, a sample of the ice-cream mixture was sent to the SIRIM QAS laboratory for chemical analysis in August 2018. The findings showed that dates seed ice cream has a high nutrient content and calorie value, and since it contains no caffeine, it can be a substitute for coffee.*

Keywords: *Consumer, Dates Seed, Food Waste, Nutrition, Innovation, Value-Added Surplus Product (VASP)*

Introduction

Food wastage is a global environmental problem (Adelodun, Kim, Odey, & Choi, 2021; Chauhan, 2020). Every year tons of food worth billions of dollars are wasted globally. Food waste is created during the process of meal preparation and can be produced from the residual of unconsumed food. It includes food that has been thrown away, not used or partly used, and without packaging materials. Food waste may have vegetable peelings, fruit scraps, tea dust, ground coffee, eggshells or unused parts of the food. Food waste is dumped at landfill sites, where it will go through the conversion process of anaerobic digestion, which produces greenhouse gases such as methane and carbon dioxide. The impact of food waste can be one of the contributing factors to disastrous climate change. The food waste problem is predicted to increase in the future due to global economic and population growth.

Certain food waste can be processed to seek its nutritional value. One such example is the dates seed. Being a well-known and highly-consumed fruit globally, especially in Arab countries, dates are usually eaten just for the flesh, a rich energy source and the seeds are often treated as waste. However, several studies have explored the potential worth of dates seed as a nutritional food. An experiment conducted by Wahini (2016) in July 2015 at the food technology laboratory in Indonesia showed that dates seed flour has such a high macronutrient value that it can substitute wheat flour. Dates seed is odourless and has a slightly bitter taste.

Many published studies regarding dates seed have disclosed the functional properties of dates seed used as food and non-food items: its thermal properties, its use in treatment and diet, its macro and micronutrient composition, phenolic acid composition, its use as an ingredient in bread, and its protein solubility (Mrabet et al., 2020; Parvin et al., 2015; Wahini, 2016). Dates seed is highly recommended for food and dietary supplement usage as it is an excellent source of dietary fibre. The total mineral content found in the single seed is comparable to the mineral content of barley. The minerals contained in dates seed include sodium, potassium, calcium, iron, copper, magnesium, manganese, zinc, phosphorus, lead, cadmium.

This beneficial information on the nutrition and health-promoting elements of dates and the seeds in our daily dietary intake should be made common knowledge for all (Ghnimi, Umer, Karim, & Kamal-Eldin, 2017; Mohamed & Chang, 2008). There have also been recent innovations in the diversification of date products based on the fruit and its seed (Mohamed & Chang, 2008; Parvin et al., 2015; Wahini, 2016; and Shokrollahi & Taghizadeh, 2016). Date's seed can be listed as a beneficial food ingredient after undergoing value-added processing during the production stage. The date's seed can be listed as a beneficial food ingredient after undergoing some value-added processing during the production stage. Figure 1 shows an example of the date and its seed. However, information on the benefits of dates seed has yet to reach members of Malaysian society. Generally, the community is still unaware that date seed is a nutritious source of dietary intake. Considering the daily increase in food waste, there is an urgent need to manage scrap by using innovative processes that would convert waste into something valuable. Green programs such as reducing and reusing food waste will improve the environment and positively impact the environmental society. As Shokrollahi and Taghizadeh (2016) proposed, studies should investigate the potential application of date seed fibre in other food products.

Hence, this study focuses on revealing the potential value and benefits of date seed powder to society. Its objective is to measure Malaysian public acceptance of the innovation of nutritional

dates seed for commercialisation. For this study, the date seed must first undergo a conversion process that transforms it into powder. This powder form of the seed is then added to the ice-cream mixture, giving the ice cream the dates seed flavour. The next stage of the study is to prove that the date seed has a high nutrition value, and this is done by sending a sample of the ice-cream mixture for laboratory analysis. Therefore, consumers are expected to enjoy the sweet taste of dates seed ice cream and gain some health benefits during the experience. The study believes that the dates seed ice cream would be able to attract the market into accepting the new product innovation, thus raising awareness of the benefits of dates seed, as well as informing the community that food waste like the dates seed can be reduced and reused by adding economic value to it. Such innovation will inculcate environmental sustainability and, in return, encourage a circular economy.



Figure 1: Dates and the seed

Literature Review

The Universality of Innovation

The market economy has witnessed protectionism and government intervention diminishing gradually. Strongly supported by the Industrial Revolution back in the 1800s, producers in Britain created new machinery to replace labour-based production. Producers have also started to compete in creating and offering new products. The Revolution was a significant turning point in the industry's history as it steered its players toward severe technological innovations in manufacturing, transportation and communication. The revolution has since then evolved gradually into the most recent Industry Revolution 4.0 (IR4.0) worldwide. The idea of IR4.0 leads to the creation of government policies that support innovation in boosting the nation's economic and social well-being. IR 4.0 promotes technology and innovation in the industry, medicine, tourism, management, operations, agriculture, education, services, and, more importantly, foods to fulfil the demand from the world's growing population.

Food is a global word. Regardless of cultures and boundaries, food is accepted as the central focus of people's daily activities. Food manufacturers have developed strategies not only to optimise but to sustain the food supply for the planet. However, the land is fast becoming

scarce, and so is its deteriorating role in supporting the agriculture sector. With the expected increase in population from 6.9 billion people today to 9.1 billion in 2050 (FAO, 2011), food innovation aims to fulfil the current and future market demands by exploiting advancements in agriculture sciences. Food innovation is concerned with linking innovation with consumers in the current and future markets, particularly in offering good quality and nutritious food. This approach has successfully encouraged players to participate in innovation activities. Thus, food innovation is expected to positively impact health and quality of life (Levidow et al., 2013).

The introduction of new components or the enhancement of existing components that profoundly affect society is referred to as innovation (Safiullin et al., 2014). On the other hand, food innovation has been described as foods created with an additional element - a technologically developed ingredient with specific benefits for the consumers (Del Giudice & Pascucci, 2010). Food innovation can be in the form of genetic engineering, agroecological engineering, marketing strategies, and product quality (Levidow et al., 2013). Genetic engineering, also known as life sciences, focuses on modifying crops and plants to enhance productivity in an unfavourable environment caused by pests, infertile soil, and drought. It also refers to the process of altering the nutritional content of plants. This is also done to counter the limited soil available for agriculture activity. The second form of food innovation is related to agroecological engineering, dedicated to boosting soil fertility, productivity, and crop protection. While innovation in marketing strategy is about seeking consumer preferences and matching them with identified products, product quality innovation aims to offer products with unique and distinctive qualities that consumers can socially accept.

Innovation, in general, is the main reason that leads to a competitive advantage amongst small firms. Unfortunately, food innovation has been the central focus in large and established companies while neglected in small firms. Generally, small food producers operate in an established and low technology area with limited R&D activities, and patenting is uncommonly conducted (Avermaete et al., 2003). Being small is a liability and poses a significant challenge that has restricted small firms from participating in innovation. Other issues that must be tackled include established expertise and competencies, which can obstruct the development of new food items (Colurcio et al., 2012). Previous empirical studies highlighted major determinants for food innovation in small firms. The deployment of internal and the utilisation of external resources contributes to improving organisational innovation capability (Colurcio et al., 2012). The latter, linked to the networking relationship between small firms with retailers, marketing agencies, suppliers, universities, research institutions, and competitors, is significant in explaining innovation activity in small firms (Avermaete et al., 2003; Colurcio et al., 2012). Existing studies consistently show the extent to which internal resources, such as qualified managerial and technical staff, contribute significantly to innovation capability (Avermaete et al., 2003).

Circular Economy and Food Innovation

Innovation in food production has somehow led to food waste. The following is an example of how our spending style often leads to food wastage. People tend to buy food excessively, especially during the promotion. Many are attracted to the food innovation itself, often resulting in the excess supplies being kept until they pass their expiry date, are spoilt, or get thrown away.

According to the Food and Agriculture Organization of the United Nations, approximately one-third of food was wasted in 2013, making food waste a global issue, although different in different parts of the world. Food waste has become a sustainable issue that negatively impacts the global society, economy, and environment and needs critical attention from the masses, concerned academics, government officials, and policymakers. This has brought about multiple parties working together today to find a solution to a global problem. From another perspective, wasted ingredients that are considered waste in producing food products can be used to produce other food products. The definition of food waste used throughout this paper follows the Food and Agriculture Organization (2014). It is "the removal of food from the supply chain which is fit for consumption, or which is spoiled or has expired, mainly caused by economic behaviour, poor stock management or neglect." It is also related to the "quantity of edible material wasted or lost in the food supply chain at various stages, including harvesting, postharvest storage and material handling, processing, distribution and consumption" (Balaji & Arshinder, 2016). The losses and waste inevitably add to existing environmental problems.

Studies have been elaborating on several factors that lead to food waste. In the consumer market, lack of knowledge in storing and cooking, lack of planning and management of purchase, coupled with the low-price level of foods, drive the consumer to buy too much food and pay too little attention to the risk of wastage (Aschemann-Witzel et al., 2015). Consumers are encouraged to purchase food excessively because commercially processed food is a relatively cheap commodity, promoting consumers to stockpile food or buy in bulk (FarrWharton et al., 2014). Retailers have also mentioned how product differentiation triggers more wastage as all of these products need to be stored while waiting for the changes in consumer tastes and preferences (Farr-Wharton et al., 2014). In the agriculture-based food industry, managing fresh food supply is a complex process due to its short life span and the perishable nature of agricultural products. Agriculture goods quickly deteriorate, resulting in a loss of value and, ultimately, a decline in quality, rendering them unfit for human consumption (Balaji & Arshinder, 2016). As a result, agriculture product innovation must be initiated to increase agriculture products' life cycle and value. The initiative will only succeed if the government, for-profit and non-profit organisations, and customers are really behind it.

The current production and consumption system in food production (in which country?) is unsustainable since little is done to sustain residue generated along with the system (Borrello et al., 2017). Porpino's (2016) study indicated several parties were seriously executing a campaign to increase food waste awareness. In the United Kingdom, the government was working on a "Love Food Hate Campaign." At the same time, non-governmental organisations from around the world such as The Robin Hood Army (India), Food Angel (Hong Kong), ReFood (Portugal), OzHarvest (Australia), Mesa Brasil (Brazil), and Rolling Harvest Food Rescue (USA) dedicated to increasing awareness on food consumption at the consumer level had taken initiatives to collect food products from retailers or individuals and channelled them to food banks, food pantries, or directly to people in need. Retailers from the United States and European nations had also offered new bulk foods segments, in which consumers were allowed to buy what they needed in a small portion.

Recently, studies have delineated the critical role of circular economy activity to address human activities' effects on the environment. In a circular economy, the world tries to extend food innovation by adopting the concept and practice of circular economy that aims to increase the efficiency of resources used to achieve a better balance and harmony between economy,

environment, and society (Ghisellini et al., 2016). A circular economy is closely related to the concept of cascading, which refers to the use of organic by-products as inputs of new products instead of being dumped in landfills as waste (Lin et al., 2013). The main idea behind the circular economy activity in the food industry concerns any process of transforming waste into higher-value products (Borrello et al., 2017). By-product materials are recycled and grounded on the principle of "waste=food" (Morena et al., 2016), resulting in what is believed to be resource sufficiency and reduction in environmental impacts (Porpino, 2016).

Foods created from by-product inputs obtained during the manufacturing of other foods are known as value-added surplus products (VASP) (Bhatt et al., 2018). These researchers suggested that in assessing consumer acceptance towards VASP, intrinsic and extrinsic cues should be used to infer product quality. While intrinsic cues describe product ingredients, extrinsic cues refer to any other aspect of the product. According to Bhatt et al. (2018), extrinsic cues like appropriate product descriptions, labels, and attributes can influence consumers' decision to purchase VASP. It is also suggested that intrinsic cues such as fat content, texture, nutrition, and several other product details are essential consumer considerations when purchasing VASP. Research has also indicated that product description, label, and benefits offered by VASP are significant factors influencing consumer decision making for such items (Bhatt et al., 2017).

Food Waste Innovation Acceptance

Food waste innovation acceptance has significantly increased globally to reduce food wastage (Martin-Rios, Hofmann, & Mackenzie, 2021; Ruggieri, Vinci, Ruggeri, & Sardaryan, 2020). In their 2018 discussion on applying innovation theory to study food waste in the foodservice industry, Martin-Rios, Demen-Meier, Gössling, and Cornuz identified a limited number of innovative food management practices. They argued that although professionals were adept at cost-saving analysis, they still lacked systematic waste reduction strategies. The study claimed that foodservice awareness was still at an infant stage due to lack of or incomplete information, poor coordination, and organisational problems. The nature of labour-intensive food service has worsened the pace of food waste innovation. Setti, Banchelli, Falasconi, Segrè, and Vittuari (2018) conducted a three-year study to establish the relationship between the food intake cycle and its contribution to waste. According to the findings, households have a more significant impact on food waste because buying is the most crucial factor in the food waste cycle.

Kasza, Szabó-Bódi, Lakner, and Izsó (2018) studied the balancing of food waste decrement in responding to food policy. The authors argued that although food waste reduction theories and initiatives are listed and assessed, the imbalance between the utilisation of expired foodstuff and leftovers without compromising food safety could only be solved by consumers and authorities in their cooperation co-development. Yearly, about 90 million tonnes of food wasted in Europe and its environment have implicated the environment, such as global warming, rather than consumed (Scherhauser, Moates, Hartikainen, Waldron, & Obersteiner, 2018). Focusing on avoiding food waste in the production processes, Scherhauser et al. (2018) suggested that the priority should be on meat and dairy products as they create most of the impacts. Food waste prevention has a significant role not only in Europe but also in all countries.

Encouraging consumers to purchase VASP is not easy as many consumers are not easily convinced of its quality. VASP is perceived as a lower quality product, often below the stipulated food production standards despite being proven otherwise by R&D. It appears that

lack of a campaign in creating awareness of VASP could be a factor that has prevented consumers from purchasing VASP. In response to this problem, this study empirically examines consumer acceptance towards VASP as part of food waste innovation.

Ice Cream with Dates Seed as a New Flavor

Good ice cream has a flavorful taste that results from flavorful ice cream ingredients. Some of the ingredients may not be sufficiently recognisable in contributing to the final taste of the ice cream. However, acceptance of the ice cream flavour will depend on individual preference. This subjective measurement is the main factor that will explain whether the flavour is well accepted in the market and vice versa.

This study conducted six nutritional analyses of energy (calories), carbohydrate, fat, protein, crude fiber, and caffeine. Energy needs to be measured because it will be produced based on a person's calories each day. Therefore, energy is measured by measuring calories. The human body gets its calories from essential macronutrients like protein, carbohydrates, and fat. While vegetables provide some calories, others like ice cream provide a much higher calorie level, carbohydrates and protein four calories per gram. In comparison, fat contains nine calories per gram (McLaughlin, 2017).

Date seeds are a natural source of dietary fibre (Bouaziz et al., 2020). Dietary fibre and crude fibre are the two most common types of fibre. Dietary fibre is a complex mixture of various materials, some of which may not have a fibrous structure (Devinder et al., 2012). This form of fibre is indigestible by the body and aids in weight loss and diabetes prevention. Lakna (2017) identified crude fibre as fibrous food residue or leftover after being dissolved in the laboratory with harsh chemical solvents like sulphuric acid and sodium hydroxide.

Caffeine is a stimulant compound found naturally in coffee, tea, cocoa (chocolate), and kola nuts (cola) and is added to soft drinks, foods, and medicine. Caffeine can cause anxiety, insomnia, nervousness, and hypertension. It is a diuretic and increases urination, but it can decrease a person's ability to lose weight because it stimulates insulin secretion, reduces blood sugar, and increases hunger. Caffeine can help relieve headaches, so several over-the-counter and prescription pain relievers include it as an ingredient, usually with aspirin or another analgesic (MedicineNet.com, 2016).

Methodology

This is a cross-sectional study that employs a quantitative research design. There are two types of primary data collection methods used. Firstly, the questionnaire survey collected potential consumer data and was distributed using the Google Form. The measurement item was adapted from the Nielsen Global New Product Innovation Survey, Q1 2015 limited (Nielsen, 2015). The survey respondents were chosen randomly to ensure that the population for this study would be anyone interested in answering the questionnaire. Researchers were able to get 301 respondents within three weeks. This study's scope is to measure the descriptive analysis and not test the hypothesis. There is no reference for a specific sample size when using the simple random sampling technique.

Secondly, a chemical analysis was conducted in August 2018 at the SIRIM QAS to determine the nutrient contents of the date seeds in the ice-cream mixture. The measurement techniques used were (1) laboratory procedure in the nutrient analysis of food and (2) a high-performance

liquid chromatography (HPLC) technique for the determination of caffeine content. This is to conform to the benefits of date seed innovation being used as an ingredient in ice cream, which is also suitable for a consumer's health.

Analysis and Discussion

Empirical Result

The main objective of the present study is to support environmental sustainability by introducing product innovation of dates seed. A descriptive analysis measured the respondents' demographic data, and the nutrients of dates seed in the ice cream were analysed and tested accordingly.

Descriptive analysis

Table 1 shows the demographic profile of 301 respondents of this study. It was found that 70.12% of respondents were female, while 29.9% were male respondents. The majority were categorised under 21 to 30 years old, while the most negligible participation was from the age group below 20 years old (2.9%). Most potential consumers worked in the private and public sectors, accounting for 29.2% and 29.6%, respectively. In terms of income level, most of the respondents (30.9% of the total respondents) earned more than RM5000.

Table 1: Demographic profile

	Categories	Frequency	Percent (%)
Gender of respondents	Male	90	29.9
	Female	211	70.1
Age of respondents	Below 20 years	8	2.9
	21-30 years	118	39.2
	31-40 years	71	23.6
	41-50 years	86	28.6
	51 years and above	18	5.7
Occupation	Student	70	23.3
	Public Sector	88	29.2
	Private Sector	89	29.6
	Self-Business	36	6
	Not Working	18	
Income Level	Below RM1000	78	25.9
	RM1001-RM2000	32	10.3
	RM2001-RM3000	41	13.6
	RM3001-RM4000	30	10
	RM4001-RM5000	28	9.3
	RM5001 and above	92	30.9

Nominal data on consumer acceptance of ice cream based on dates seed innovation

Based on Table 2, 69.4% of the respondents were consumers of dates and liked to eat the fruit, while 88.4% were aware that dates are nutritious. About 48.2% stated that they never experienced consuming any product based on dates seed. However, 84.4% of them were interested in the dates seed ice cream, while 94% agreed that the new ice cream is an innovative consumer product. The survey found that 84.7% were interested in the dates seed ice cream if

it was on sale in the market. This shows that this food waste innovation is well accepted among potential consumers and has a market value. They were interested in getting more information about the ice cream and were eager to try the product as they noticed the dates' nutritious value. They were also curious because they never knew that such a flavour existed.

The findings revealed that most respondents knew dates as a healthy fruit but not the dates seed itself. Although the dates seed potential is known (Mohamed & Chang, 2008; Parvin, 2015; Wahini, 2016; and Shokrollahi & Taghizadeh, 2016), it has yet to be commercially introduced to the market. For the present study, although the respondents had not tasted date seed ice cream before, they still gave positive feedback on the new flavour based on their knowledge of dates as a flavorful fruit. The respondents' positive acceptance suggested that the innovation could be seen as a potential solution to balancing food waste by utilising expired food (Scherhauer et al., 2018). Furthermore, the empirical findings support Setti et al. (2018). They claimed that the respondents' willingness to purchase the dates seed flavoured ice cream had significant outcomes – in a way – in the ice cream lovers' food purchase choice. The survey surprisingly indicated the potential market for the seeds of the dates ice cream, as shown in Table 2.

Table 2: Consumer acceptance of ice cream based on date seed innovation

Questions	Answer	Frequency	Percent (%)
Are you a fan of dates?	Yes No	209 92	69.4 30.6
Are you aware of the nutrition content of dates?	Yes No	266 35	88.4 11.6
Have you ever consumed any product that is based on dates seed?	Yes No	145 156	48.2 51.8
Are you interested in ice cream, which is based on dates seed?	Yes No	254 47	84.4 15.6
Do you think that ice cream based on dates seed is an innovative product?	Yes No	283 18	94 6 5.4
Are you interested in buying ice cream based on dates seed if it is available in the market?	Yes No	255 46	84.7 15.3

Chemical analysis

The two types of chemical analyses were conducted using a laboratory procedure in the nutrient analysis of food and the high-performance liquid chromatography (HPLC) technique to determine caffeine content at the laboratory of SIRIM QAS, Shah Alam in August 2018. Analysis of the 100 gram sample of dates seed ice cream revealed the following: 136 grams or 81% contained calories, 26.5 grams or 16% contained carbohydrates, 4 grams or 2% contained protein, 1.5 grams 1% contained fat, 0.9 gram or 1% contained crude fibre. Surprisingly, there was no trace of caffeine at all. The findings help confirm that date seed can be a good substitute for coffee since it has no caffeine. Fig. 2 shows the result of the nutrient analysis of the seeds of the dates ice cream.

Dates seed ice cream is innovated and created especially for ice cream lovers with high blood pressure, anxiety, insomnia, and anaemia. Since caffeine is not recommended for anaemic, cardiovascular, and hypertension patients, seed-based ice cream is the best alternative food for

a snack or dessert. Most importantly, the innovative product has a nutritional content and is free from caffeine. MedicineNet.com (2016) highlighted the effect of caffeine to ease anxiety, insomnia, and hypertension. Caffeine presence is famous as a stimulant compound in many drinks and medicine. Scientifically, this study has reconfirmed the food test by Wahini (2016), particularly on dates seed. The experiment revealed that seeds contained high energy, moderate carbohydrate levels, and an acceptable fat limit other than protein and fibre. The other concern of this study is fibre and caffeine. Lakna (2017) explained that crude fibre is good for digestion, while a caffeine-free dates seed ice cream can substitute for coffee, particularly for a person who is on a diet. This finding is consistent with the study by Del Giudice and Pascucci (2010). They claimed that food innovation could be invented with an additional element, i.e., a technologically-developed ingredient with the specific benefit of a nutritional food source for the consumers. Furthermore, this study fulfilled the suggestion given by Setti et al. (2018) that consumer behaviour in the household food waste context is related to food purchase choice. Notably, the innovation of food waste in this current study will benefit consumers, as suggested by Mohamed and Chang (2008), Parvin et al. (2015), and Shokrollahi and Taghizadeh (2016).

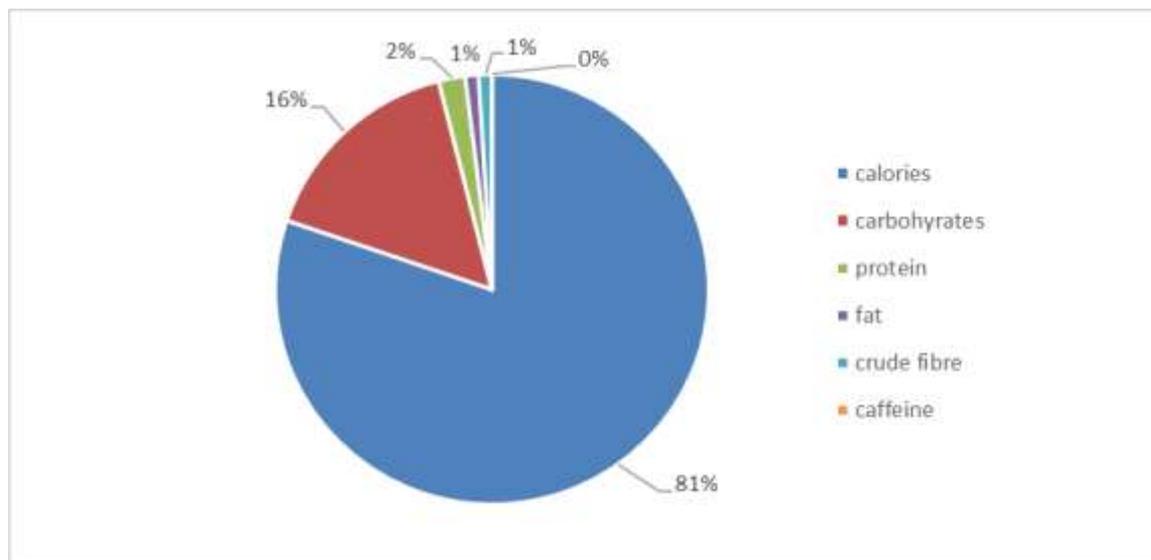


Figure2: Result of nutrient analysis of date seed ice cream

Source: Analysis conducted at the laboratory of SIRIM QAS, Shah Alam in August 2018.

Using date seeds in product innovation raises the usage of the seeds and adds to it an economic value while managing the food waste issue. This study is aligned with the study conducted by Bhatt et al. (2018), who suggested that the measurement of intrinsic and extrinsic cues should be used to determine product quality. Thus, it will influence consumer acceptance of VASP. The survey results indicated that consumers were concerned with the benefits of dates seed: the gauge of VASP acceptance such as energy, fat, crude fibre, caffeine, and other nutrition as an essential consideration in purchasing the ice cream. Indirectly, we are practising a circular economy which is the global in-trend practice. The innovation of date seed waste is a branch of food technology in product quality, categorised by Levidow et al. (2013).

Conclusion and Recommendation

This experimental design study exemplifies a new dimension in the date seed potential as a food waste innovation. As a whole, the present study emphasises the growing number of young and educated people in the world who are now becoming positive towards the innovation of technologically-based products. Research and development in healthy food have increased due to the rising percentage of consumers seeking healthy food. This study successfully examined consumer acceptance of the innovation of nutritional food waste. The survey findings showed that dates seed-flavoured ice cream might have a high potential to be marketed and accepted by health-conscious people. Dates seed-based food innovation can be created with an additional element to its ingredient, which is technologically developed and has specific benefits as a healthy food source. Thus, this study hopes to contribute to consumer behaviour change in the household food waste context concerning their food purchase choice. Globally, food waste consumption may also help the foodservice industry create an incentive for a green environment for all. The findings will also enrich the literature on the benefits and usage of date seed as a nutritional food source. It is, therefore, imperative that food manufacturers and consumers take the opportunity to value the benefits by utilising this nutritious source in their dietary intake. The knowledge derived from this study may provide additional insights into the Malaysian Dietary Guidelines' recommendation (2010) – that consumers should make a wiser food choice by consuming healthy food.

This study is not free from limitations. The chemical analysis was only based on the six basic parameters outlined in the preliminary study on dates seed. Possibly more information on other vital nutrients could be made available as value-added in the ice cream innovation. This study suggests that ice-cream packaging needs to be attractive, indicating the halal (permissible) status, nutritional facts, and various colours in ensuring product sustainability. Besides that, plenty of promotion on this innovative and healthy ice cream should also be carried out to highlight the uniqueness of the dates seed ice-cream flavour. Future studies could also be done to analyse other nutrients in the dates seed and explore more areas of its usage for domestic and commercial purposes.

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