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Development of mixed dried vegetables and fruit rag snack by utilizing Malaysian availability ingredients

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The aim of this research is to develop a mixed dried vegetables and fruit rag snack by using Malaysian local plant source. The local plant source used to prepare mixed dried vegetables snack food were carrot, *kalian*, purple cabbage, and jackfruit rags. It is a vegetable-based snack developed for different group of ages from children to elderly people. Proximate analysis, energy value, total carbohydrate content, water activity value, total aerobic bacteria plat count (TPC), total yeast and mold count (TYMC), total phenolic content, total flavonoid content, antioxidant activity, and sensory evaluation of prototype were conducted. The developed mixed dried vegetables and fruit rag snack contains 9.82% of moisture, 7.55% of crude protein, 2.68% of ash, 10.49% of crude fat, 17.37% of crude fiber, 69.49% of total carbohydrate, 28.13 kcal of energy, and 0.43 of water activity. The obtained results of TPC and TYMC showed 1.70 x 10^4 CFU/g and 1.00 x 10^3 CFU/g, respectively. The mixed dried vegetables and fruit rag snack indicated high total phenolic, total flavonoid, and antioxidant activity values. The developed snack food was highly acceptable by all panellists which can be hypothesized that it has high potential to be commercialized.

Keywords: dried vegetables, dried jackfruit rags, chemical composition, microbiological analysis, sensory evaluation

INTRODUCTION

Nowadays, there have been emerging complicated disease regards to poor eating habits. Recent studies have implicated dietary factors in the cause and prevention of several important diseases such as cancer, coronary heart disease and diabetes with other mild consequences such as elevated blood pressure, weight gain and others (Ezzati and Riboli, 2013). Higher dietary saturated fat is associated with an increased risk of cardiovascular diseases, as for instance usual consumption of processed meat was related to the high risk of coronary heart disease (Tapsell et al., 2016). This are widely due to the lack of nutritious food consumption in daily diet and where people more interested in consuming meat based products which are high in fat content.

There is strong evidence that fruits and vegetables protect against several chronic diseases including coronary heart disease (Dauchet et al., 2006). There are several indications that a diet rich in fruits and vegetables can provide some protection against coronary heart disease and number of cancers due to the antioxidant activity (Yao et al., 2004). Vegetables make up a major portion of the diet of humans in many parts of the world and plays an important role in human nutrition. Vegetables has rich sources of vitamins for example vitamin C, A, B1, B6, B9 and E, minerals, dietary fibre and phytochemicals that may have antioxidant properties. This prevention of cancer and cardiovascular disease has been

related to specific nutrients contained in pure fruit and vegetables juice, generally its phytochemicals components particularly flavonoids (Ruxton et al., 2006).

Like many other coloured vegetables, carrot is also rich with antioxidants. According to da Silva Dias (2014), carotenoids, polyphenols and vitamins largely present in carrot which can act as antioxidants, immuno-enhancers, and anti-carcinogens. Hence, reduce the risk of cancer. It is also described as an anti-diabetic, anti-hypertensive as well could reduce cholesterol and cardiovascular disease potential (da Silva Dias, 2014). Moreover, carotenoids are widely distributed in orange carrots which is a potent antioxidants that has the ability to neutralize the free radicals from surrounding (Dias, 2012; Sun et al., 2009). Zhang and Hamauzuet (2004) reported that flavonoids and phenolic derivates, present in carrot roots play also an important role as antioxidants. They also exert anti-carcinogenic activities, reduce inflammatory insult, and modulate immune response (Dias, 2012; Sun et al. 2009).

Kailan also known as Chinese Brocolli which is a nutritious green vegetable which contains many nutrients such as Beta carotene, vitamin K, vitamin C, lutein, zeaxanthin and high calcium (USDA, 2007). This was further proofed where *Kailan* generally contain considerable carotenoids, calcium, ascorbic and iron content depending on season (Hanson et al. 2011). It contains higher vitamin C than orange and also can provide higher vitamin A than another green vegetables where it can function as natural antioxidant and anti-inflammatory. According to Philip (2011), *Kailan* is the source of phytonutrients that can help support a healthy human body. *Kailan* contains multiple nutrients with potent anti-cancer properties, such as diindolylmethane and small amounts of Selenium. The 3, 3-di-indolylmethane found in it is a potent modulator of the innate immune response system with- anti-viral, anti-bacterial, and anticancer activity (Phillip, 2011).

Furthermore, purple cabbage also called as red cabbage scientifically known as *Brassica oleracea L. var. capitata L. f. rubra*is is one of the most important vegetables grown around the world for consumption and has been in spotlight for probable approach on physiological act (Chigurupati et al. 2002). According to Wiczkowski et al. (2013), purple cabbage has been used for therapeutic purposes. Zielińska et al., (2015) showed the potential of extract from purple cabbage as dietary supplement in treatment of inflammatory bowel. In addition, according to Podsędek (2007), the acylated anthocyanins, carotenoids, tocopherols, and glucosinolates from purple cabbage are responsible for health benefits.

Jackfruit is a non-seasonal fruit that has an average weight of 10 kg (Ranasinghe et al., 2019) which are widely cultivated in Malaysia. The flesh of jackfruit is usually consumed freshly, vacuum dried or used in the making of snacks, jams, ice cream and bakery products. It consists of many large kernel segments or aril as the edible part, separated into compartments by latex-like filaments called “rags”. However, the jackfruit rags which comprise about 25% of fruit weight are generally discarded as waste (Dam and Nguyen, 2012) even though the rags are rich in dietary fibers, carotenoids and vitamin such as ascorbic acid, thus, the waste management at this point is very important in order to fully utilize the nutrition on of the jackfruit especially in large scale food manufacturing (Ranasinghe et al. 2019).

Processing of fruits and vegetables are much needed due to their high water content which made them perishable. Yadav and Singh (2014) stated that preservation of fruits and vegetables would diminish or profoundly reduce spoilage rate caused by microorganism that would affect quality, palatability and nutrition value. Usually, freshly harvested fruits and vegetables consist 90-95% of moisture content which is the leading cause to promote spoilage (Sabir and Farooquie, 2015). Khan (2012) reported that fruit during peak season become easily rotten due to the lack of insufficient storage and preservation method. The study mentioned that osmotic dehydration is the best preservation method to increase the shelf life of perishable plant such as fruits and vegetables (Khan, 2012).

Osmotic dehydration is one of the methods used to preserve fruit and vegetables. It can be performed by placing the whole or in pieces of solid food in solvent such as sugar or salts solutions (Tiwari, 2005). According to Yadav and Singh (2014), this method involve two major simultaneous counter-current flows. A semi-permeable membrane could be permeated by sugar or salt solution molecules, however, not for the solute molecules. By incorporating this method, it will help in reducing moisture content of the vegetables and fruits in producing dried food products (Yadav and Singh, 2014).

Based on the above mentioned points, this study was conducted in order to develop a mixed dried vegetables and fruit rag snack that consist of

carrot, *Kailan*, purple cabbage and employing jackfruit rag as the main ingredients with other natural seasonings to enhance the original flavour of the snack itself. The proximate composition, total plate count, antioxidant analysis and sensory acceptability of the processed food product were investigated. This product is anticipated to provide an alternative source of floss to vegetarian and enhance awareness of vegetables consumption.

MATERIALS AND METHODS

Raw materials preparation

Carrot (*Daucuscarota*), *Kailan* (*Brassica oleracea var. alboglabra*) and purple cabbage (*Brassica oleracea var. capitata f. rubra*) were obtained from Giant Hypermarket in Besut, Terengganu. Rags of jackfruit were collected from local wet market in Besut, Terengganu. On the same day of collection, the rags of jackfruit were soaked in 0.2% sodium metabisulphite for 20 minutes before being vacuum-packed and kept at -18℃ prior used for processing.

Pre-treatment of raw materials

All raw materials were washed with water before processing. Peeled carrot and *Kailan* were soaked in sodium metabisulphite solution (0.2 %), separately for 15 minutes and then rinsed with water. For *Kailan*, the stems and leaves were blanched in 90 °C water for 1.5 minutes and 1 minute, respectively. The stem and leaves of *Kailan* were continued with osmotic dehydration by being soaked in 1% of salt solution for 15 minutes at room temperature.

Purple cabbage was blanched in 1% salt solution at 90°C for 1 minute. Purple cabbage was continued with osmotic dehydration by being soaked in 1% of salt solution for 15 minutes at room temperature.

Rags of jackfruit were heated in 0.2 % sodium bicarbonate solution at 60°C for 30 minutes and was continued boiling for 2 minutes.

Processing of raw materials

Carrot was transformed into shreds by using shredder. *Kailan* and purple cabbage were formed into sheets by grinding, rolling and sheeting.

Carrot shreds, *Kailan* sheets and purple cabbage sheets were dried in hot-air dryer (55 °C; 3 hours). Dried carrot shreds were seasoned with flour, corn oil, five spices, pumpkin seed powder, peppers, salt and baked in oven at 150 °C for 10 minutes. Dried *Kailan* and purple cabbage sheets were baked in oven at 100 °C for 10 minutes.

Rags of jackfruit was blended into paste and mixed with tapioca flour at a ratio of 90:10. The reformed jackfruit's tendrils was spread into a thin layer and freeze at -18 °C for 2 hours. The frozen jackfruit's tendrils layer was par-baked at 150 °C for 10 minutes and then fried at 160 °C for 10 minutes by using air-fryer.

Composition of mixed dried vegetables and fruit rag snack

Mixed dried vegetables and fruit rag snack was made up of carrot floss (80%), jackfruit's rags (10%), *Kailan* (5%) and purple cabbage (5%) based on weight basis (Figure 1).

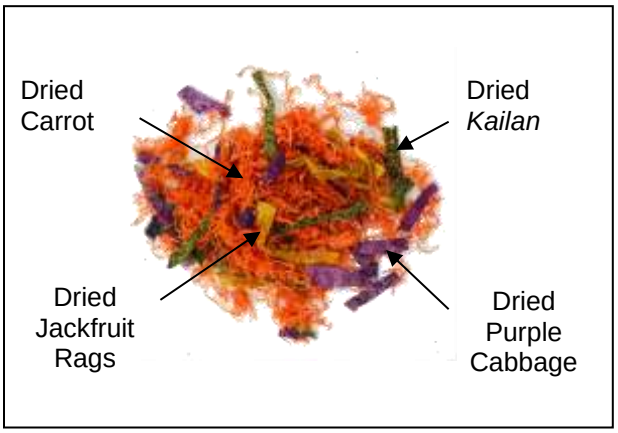

Figure 1: Composition of mixed dried vegetables and fruit rag snack

Determination of proximate analysis

The proximate composition such as moisture, crude protein, crude fat, ash, and crude fibre of the finish product were determined according to method proposed by AOAC (1995). The protocol of the Oven drying method (AOAC method 977.11), Kjeldahl's method (AOAC method 955.04), Soxhlet method (AOAC method 960.39), dry ashing method (AOAC method 923.03), and gravimetric method (AOAC method 991.43) were followed in order to analyze moisture, crude protein, crude fat, ash, and crude fibre contents, respectively.

Calculation of total carbohydrate

The total carbohydrate of the end product was computed by difference using formula proposed by BeMiller and Low (1998); whereby, carbohydrate = 100 g – (moisture + crude protein + crude fat + ash) g.

Calculation of calorie

The end products' calorie was computed according to formula proposed by Nielsen (1998); whereby, energy = (crude protein × 4) + (carbohydrate × 4) + (crude fat × 9).

Water activity (a_w) Measurement

The water activity of the sample was analysed using an Aqualab Series 4 water activity meter (Aqualab dew point water activity meter 4TE, Washington, USA) (±25 °C). Solid pieces of sample (about 2 g) were placed on plastic cups and were inserted into a pre equilibrated headspace of the sealed chamber to begin the analysis.

Microbiological analysis

End product (25g) was dispensed into a sterile stomacher bag containing peptone water (0.1%; 225 mL) (ISO, 2001). The mixture was then homogenized with stomacher for 90 seconds to form homogenate 10^{-1}. Further serial dilutions (10^{-2} to 10^{-7}) were prepared. Approximately 100 µL of each dilution was pipette and spread onto agar plates. For aerobic bacteria plate count, the plate count agar (PCA) was used and incubated at 37±1°C for 24, 48 and 72 hours after spread plate. For moulds and yeast count, potato dextrose agar, (PDA) medium was used. The spread plate was incubated at 25°C for five days. The numbers of bacterial colonies were expressed in log CFU/mL.

Total phenolic content

The total phenolic contents of each extract was determined according to the Folin–Ciocalteau reagent by using 96-well plate (Slinkard and Singleton, 1977). Each 20 µL of extracts or gallic acid (standard) and 20 µL of distilled water (blank) were added into the separate wells. Next, the mixture was added with 100 µL of Folin-Ciacalteau phenol reagent and incubated for 5 minutes at room temperature. After 5 minutes, 80 µL of 7.5 % sodium carbonate solution was added to the mixture and mixed well. These mixture solution was incubated for 30 minutes under dark condition. After incubation, the absorbance of color changes was measured at 760 nanometer (nm) by using microplate reader versus prepared blank. The concentration of phenolic in the extract was determined by plotting the absorbance value on a series of gallic acid calibration curve equation. The total phenolic content was expressed as gallic acid equivalents (GAE) per gram of sample.

Total flavonoid content

The total flavonoid content (TFC) was determined according to a modified protocol by Chen and Li (2007). A quercetin was used as a standard. Approximately, 25 µL of sample mixture or standard quercetin, 125 µL of distilled water and 10 µL of 5% sodium nitrite was added into 96-well plate. After 6 minutes, 15 µL of 10% aluminium trichloride solution was added and the mixture was allowed to stand for 5 minutes at room temperature.

Then, 50 µL of 1.0 M sodium hydroxide was added and shaken for 1 minute. The absorbance was measured and read at 595 nm by using a microplate reader. A calibration curve was obtained by plot the graph of absorbance against the concentration of quercetin. The total flavonoid content was expressed as mg of quercetin equivalents (QE) per gram of sample.

DPPH scavenging assay

The 1, 1-diphenyl-2-picryl-hydrazyl (DPPH) radical scavenging assay was conducted according to the method described by Wan Nadilah et. al. (2018). The assay was conducted in a 96-well microplate. Aliquots (50 µL) of each serial dilutions of the test sample and quercetin (positive control) were transferred into each well. This followed by the addition of DPPH solution (100 µL), which was prepared beforehand at concentration of 59mg/L into each well. The microplate was then incubated in the dark at room temperature (30 minutes). The absorbance of the reaction mixtures was measured using a microplate reader at 517 nm. The result was expressed in mg of quercetin equivalents (QE) per gram of sample.

Sensory evaluation

The sensory attributes such as colour, aroma, texture, taste, and overall acceptability of the end product were assessed at *Pasaraya Pantai Timur* in Kampung Tanduk, 22000 Jerteh, Terengganu, Malaysia. Customers (121 subjects) which consisting of male and female, age from 7 to 53 years old was participated in this evaluation. Five faces scale was used to conduct the sensory evaluation; a smile represents 'very like' to a frown represents 'very dislike' (Stone et al. 2012).

Statistical analysis

All the obtained data in this research was analyzed using SPSS (Statistical Package for the Social Science; version 17 software). The results showed in this research are represented as n=3 ± s.d; whereby, n represented as mean values of

triplicates. Tukey Kramer procedures was followed to determine the significant difference among the samples at significance level of $p<0.05$.

RESULTS AND DISCUSSION

Proximate composition

The results of proximate composition and energy value of mixed dried vegetables and fruit rag snack are shown in Table 1. Moisture content of the product was 9.82%. The result was expected low because it was a dried product. For the crude protein content, the produced product had 7.52% of crude protein. Ash is referring to any inorganic material such as minerals that present in a food. It can include essential minerals such as calcium and also potassium. According to Baker (2019), any natural food contain less than 5 % of ash while for processed food, it can have ash more than 10 %. For the mixed dried vegetables and fruit rag snack, the ash content was 2.68 % where it is mostly contributed by the ash content of the carrot which is 1.027 % (Manorama and Shridar, 2012). Carrot is believed as a good source of beta-carotene, fiber, vitamin K, potassium and also antioxidants (Bjarnadottir, 2015).

Table 1. Chemical composition and water activity (a_w) of mixed dried vegetables and fruit rag snack

Composition	Dry weight basis (%)[a]
Moisture	9.82 ± 0.00
Crude protein	7.52 ± 0.23
Ash	2.68 ± 0.00
Crude fiber	17.37 ± 0.04
Crude fat	10.49 ± 0.76
Carbohydrate[b]	69.49
Energy (kcal)[b]	28.13
Water Activity (a_w)	0.43 ± 0.01

[a]Values are shown as mean ± standard deviation
[b]Values obtained by calculation (g/100 g of dry matter)

The value of crude fiber was 17.37%. The product has high fiber content as it consists of three vegetables (carrot, *Kailan*, and purple cabbage) and jackfruit rag. In elegant work reported by Slavin and Lioyd (2012), most of vegetable and fruit was concentrate in insoluble fiber and not soluble fiber; insoluble fiber helps in increasing stool weight. Vegetables was a good source in fiber and assist to lower the body cholesterol level, thus decrease the risk of cardiovascular diseases (Hanif et al., 2006).

Table 1 showed the value for crude fat (10.49 %), total carbohydrate (69.49 %) and energy (28.13 kcal) of the product. Almost all fruits and vegetables are low in fat and high in vitamins, minerals and fiber (Meixner, 2018). The fat content of mixed dried vegetables and fruit rag snack is particularly contributed by the application of corn oil onto carrot shreds and also small amounts of fats found in each vegetables used.

Water activity (a_w) of mixed dried vegetables and fruits snack was 0.43. This indicates that the growth of bacterial ($a_w<0.75$), moulds and yeast ($a_w<0.6$) was inhibited (Safefood 360º, 2014). Generally, dried fruit has water activity of 0.76 while dried vegetable has water activity in the range of 0-0.5 (Safefood 360º, 2014).

Microbiological analysis

Aerobic bacteria is an important indicator of hygienic food production and handlings. Table 2 showed the aerobic bacteria of mixed dried vegetables and fruit rag snack. Mixed dried vegetables and fruit rag snack was recorded to have lowest aerobic bacteria count (1.5×10^4 CFU/g) during the first 24 hours incubation at 37°C Aerobic bacteria count of sample showed no significant ($p>0.05$) different and became constant (1.7×10^4 CFU/g) when it was further incubated for 48 hours and 72 hours. This indicates that time has no significant ($p>0.05$) effect on the total aerobic count of mixed dried vegetables and fruit rag snack. The final aerobic bacteria count of 1.7×10^4 CFU/g was in accordance to the guidelines by Gilbert et al. (2000) which dried fruit and vegetable should contain aerobic bacteria less than 10^5 CFU/g. Moreover, current aerobic bacteria result was lower than previous study reported by Ntuli et al. (2017) that dried traditional vegetables contained 5.4 x 10^6 CFU/g of bacteria. This was attributed to a low water activity of mixed dried vegetables and fruit sample produced by convective air-drying. According to Perera (2005), bacteria are not able to survive at water activity (a_w), below 0.85. This is in agreement to current result, whereby mixed dried vegetables and fruit rag snack has water activity, a_w of 0.43 (Table 1). DiPersio et al. (2007) also reported that microorganisms of carrot slices were reduced to 1.6–1.7 log CFU/g after convective air drying at 60°C for 6 hours.

Yeast and mold are indicator of food contamination during harvest or food processing. Table 3 showed the total yeast and mold count of

mixed dried vegetables and fruit rag snack.

Table 2;Total aerobic bacteria count of mixed dried vegetables and fruit rag snack at different incubation hours at 37°C ± 1

Incubation hours	CFU/g (×10^4)
24	1.50^a
48	1.70^a
72	1.70^a

The numbers represent mean ± sd of three replications. Mean values in the same column with same superscripts are not significantly different (p>0.05).

Total yeast and mold count showed no significant (p>0.05) difference (1.0×10^3 CFU/g) and remained constant when it was incubated for five consecutive days at 25°C ±1. The obtained result of yeast and mold count was in line with the recommended guidelines for dried fruits and vegetables which the yeast and fungi counts should not exceed 1.0×10^3 CFU/g (Witthuhn et al., 2005). Tournas (2005) reported that fresh carrots showed average mould and yeast counts of 5.3 x 10^4 CFU/g. Current yeast and mold result was lower than study of Ntuli et al., (2017), who reported that dried traditional vegetable contained average yeast and mold of 9.4 x 10^5 CFU/g. This was attributed to the low water activity of mixed dried vegetables and fruit which was 0.43 (Table1). According to Perera (2005), growth of yeasts and mold will be inhibited at water activity below 0.7 and 0.65 respectively. Presence of yeast and mold may due to product has undergo handling such as cutting which may damage cells of the outer skin layers of vegetables, thus facilitating entrance of organisms such as yeasts (Tournas, 2005).

Table 3; Total yeast and mold count for five consecutive days at 25°C ±1

Days	CFU/g (10^3)
1	1.00^a
2	1.00^a
3	1.00^a
4	1.00^a
5	1.00^a

The numbers represent mean ± sd of three replications. Mean values in the same column with same superscripts are not significantly different (p>0.05).

Total phenolics

Polyphenols or 'plant phenols' are naturally occurring compounds found largely in the fruits, vegetables, cereals and beverages. Polyphenols are secondary metabolites of plants and generally involved in defence against ultraviolet radiation or aggression by pathogens (Beckman, 2000). Different origin of plant species has different levels of total phenolic contents. Within the present study, aqueous sample extract was prepared to examine the total phenolic contents. The yield of total phenolic contents in the sample shown significantly higher, which was 3836.79 mg GAE/g of sample (Table 4). Various studies have confirmed that vegetables are high in polyphenols such as phenolic acids, flavonoids and anthocyanins, and that these natural antioxidants (Hu, 2003). In general, green leafy vegetables contain an immense variety of bioactive non-nutritive health enhancing factors as it has an abundance of phenolic compounds (Mohankumar, 2018). For the carrot, its phenolics are present throughout the roots but are highly concentrated in the periderm tissue (Mercier et al., 1994). In addition, one of the ingredient in the samples extract was jackfruit rag, which is known as rich source of phenolic compounds including flavonoids. Total phenolics in jackfruit were reported to an extent of 45 mg/100 g (Saxena et al., 2009).

Table 4; Total phenolics, total flavanoids, and DPPH scavenging activity of mixed dried vegetables and fruit rag snack

Parameter	Amount
Total phenolics (mg GAE/ g of sample)	3836.79 ± 608.85
Total flavanoids (mg Que/ g of sample)	487.97 ± 137.80
DPPH scavenging activity (mg Que/ g of sample)	181.39 ± 100.18

Values are shown as mean ± standard deviation.

Total flavanoids

In plants, flavonoids occasionally occur as a glycone, although the most common forms are glycoside derivatives. These compounds account for 60% of total dietary phenolic compounds (Harborne and Williams, 2000). Flavonols are the most prevalent flavonoids in the plant kingdom and glycosides of quercetin are the most predominant naturally occurring flavonols (Harborne and Williams, 2000). Among flavonoids, isoquercetin (quercetin-3-glucoside) and rutin (quercetin-3-rutinoside) were the most common forms found in the leafy vegetables. Flavonoids are used by vegetables for their growth and defence against plaques (Havsteen, 2002). They belong to a class of low-molecular-weight phenolic compounds that are widely distributed in the plant

kingdom. From the result obtained, the yield of total flavonoid content in the sample extract is quite high, which was 487.97 mg Que/g of sample (Table 4). The differences in the flavonoid structures and their substitutions in each ingredients of sample extract influence the result obtained, thereby affecting the antioxidant properties of the flavonoids.

DPPH scavenging activity

The 1,1–diphenyl-2-picrylhydrazyl (DPPH) scavenging method is one of assays to analyze the antioxidant potential via scavenging the free radical by the test sample (Alam et al., 2012). The molecule of DPPH is characterized as a stable free radical and can be reduced to dipicrylhydrazine due to the delocalization of electron (Alam et al., 2012). The reduction of deep violet colour to light yellow occurs when the DPPH solution was mixed with sample that can donate hydrogen atom and the reduction of the colour can be measured at the wavelength of 517 nm. Therefore, any substance capable of this reaction is considered as antioxidants (Mahmod et al., 2017). The scavenging effect of the product sample on DPPH radical obtained was 181.39 mg Que/g of sample (Table 4). The value obtained for the antioxidant activity of the sample may be contributed by the presence of phenolic compounds in carrots, *Kailan*, purple cabbage as well as jackfruit rags. Carrots usually contain high amount of α- and β-carotene which act as the precursors of vitamin A as well as an excellent antioxidants (Leja et al., 2013). For the purple cabbage, the amount of total phenolic contents was much higher due to the phenylpropanoids and anthocyanins groups (Leja et al., 2010). *Kailan* was also observed to have high amount of antioxidants due to the high amount of total phenolic compounds which composed of hydroxycinnamic acids and derivatives as well as flavonoids and derivatives (Zhifeng et al., 2018). The antioxidant obtained from the jackfruit was mainly from the carotenoids including all-trans-β carotene (Swami et al., 2012).

Sensory evaluation through market survey

Sensory evaluation is a scientific discipline applied to assess, analyze, and interpret the consumers' reactions towards to the properties of foods and other subjects as regarded by the five common senses such as sight, smell, touch, hearing, and taste (Stone et al., 2012). According to Parn et al., (2015), sensory evaluation is important for marketing purposes, whereby, the results give in-depth insight on the preference and overall acceptance towards product. The sensory evaluation scores of the mixed dried vegetables and fruit rags snack are shown in Table 5. The mixed dried vegetables and fruit rag snack was acceptable as the product received score in the ranges 4 with respect to the colour, aroma, texture, taste and overall acceptability. Colour is a first perceived characteristic that plays a vital role on the acceptability or even rejection by consumers (Malawat and Hidayah, 2013). Based on the obtained results, panelists rated the developed product as "like" with the score value of 4.29 for overall acceptability. This indicates that consumers preferred colour of the product which are colorful with score 4.39, acceptable texture with score 4.20 and taste with score 4.16. It was predicted that the natural taste of the mixed dried vegetables and fruit rag snack was evident that it was liked by the panelists. The aroma of the product was also from the natural spices used such as flour, corn oil, five spices, pumpkin seed powder, peppers and salt which improved the interest of the panellist towards the product.

Table 5;Score of sensory evaluation of mixed dried vegetables and fruit rag snack.

Attribute	Score
Colour	4.39 ± 0.65
Aroma	4.31 ±0.69
Texture	4.20 ±0.76
Taste	4.16 ±0.89
Overall Acceptability	4.29 ±0.71

Values are shown as mean ± standard deviation

CONCLUSION

The developed mixed dried vegetables and fruit rag snack using Malaysian availability ingredients provided convenient and healthier snack for vegetarian and non-vegetarian as it is source of protein and present of natural antioxidant. The developed mixed dried vegetables and fruit rag snack also can be considered as safe food to be consumed as it contains very low water activity value. The sensory evaluation results showed the developed mixed dried vegetables and fruit rag snack received a high acceptance by panellists which can be hypothesized that it has great potential to be commercialized.

CONFLICT OF INTEREST

All the authors declare 'no conflict interest' exist in current reported work.

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AUTHOR CONTRIBUTIONS

All authors conducted the experiment, wrote and reviewed the manuscript. All authors read and approved the final version.

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