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ORIGINAL ARTICLE

Development and Evaluation of Dabai Kernel (Canarium Odontophyllum *Miq.*) Spread

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ABSTRACT - Beside from delicious and beneficial flesh, dabai industry generates significant amount of edible waste particularly known as dabai seeds. This potentially commercialisable dabai seeds contains valuable amount of starch and protein which remains unexploited. This research describes an attempt to study the consumer acceptability of spread as well as nutritional contents and texture profile analysis of spread produced from the dabai seeds. Drying, roasting and grinding are among the techniques that engaged to produce dabai kernel spread. The physicochemical results shown significant increasing trends as the percentage of dabai kernels incorporation in the formulations increased. Most of the panelists preferred Formula 2 spread as displayed significant overall acceptance and high purchase intention from the sensory evaluation. Based on previous studies, the nutritional analysis revealed that the compositions of kernel from dabai seeds were carbohydrate (mainly starch) 47%, protein 11%, fat 26% and other components 16%. The other properties of the dabai kernel spread such as texture and colour are expected to be comparable with the commercial spreads produced from nuts.

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INTRODUCTION

In Sarawak, dabai is known for a few common names such as Sibu Kanna, black olive, or Sibu Olive due to its high similarity physical appearance, flavour and texture with olive [1]. Dabai peel appears white when immature while dark purplish when mature. The flesh turned yellow to golden flesh when it matures completely [2]. A dabai fruit comprises 61.4 % of pulp, 37.0 % of the seed and 5.6 % of peel [1]. The peel, flesh and kernel of dabai are edible except for the part of the endocarp which is non-edible (refer Figure 1). Typically seed is discarded even though the kernel is edible. As the economic potential has not been completely discovered because of the shortage of promotion, dabai fruit is classified as an underutilized fruit. Lately, Agriculture Department of Sarawak reported dabai fruit as a specialty fruit due to its high nutritional content [3; 4]. One area of processing of dabai fruit which has not received much attention in Sarawak is utilizing them in breakfast products that can be used in the household. An example of such a product is the dabai kernel spread.

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Figure 1. Dabai flesh (left) and its kernel (right) from the seed.

The objectives of this study are to determine the feasibility of producing table spread from the dabai kernels, secondly to characterise the spread produced from the dabai kernels in terms of physicochemical properties and lastly evaluation of the organoleptic properties of the table spread derived from the dabai kernels in terms of colour, aroma, texture, spreadability, taste and purchase intention.

MATERIALS AND METHODOLOGY

Materials

Dabai fruits and peanuts were purchased from the local wet market in Sibu, Sarawak. Dabai fruits were packed in plastic bags and stored inside a cold room (-4^{o}C). Peanuts were stored in an air tight container under dry room temperature. All the ingredients were purchased from the local supermarket in Sibu, Sarawak. All chemical reagent are either food or analytical grades were used in this research.

Production of Dabai Kernel Spread

Dabai kernel and raw peanuts were used in the production of spread. The dabai fruits were washed and rinsed thoroughly with potable water and the flesh was isolated manually. The dabai seeds were crushed by using mortar and pestle, and the kernels obtained were dried inside the drying oven at 40 to 50 ^{o}C for 5 hours before storing inside an air tight container. Before producing spreads, the kernels obtained were roasted in the baking oven at temperature 100-120 ^{o}C for 20 minutes. Raw peanuts were roasted in the baking oven at 120 to 150 ^{o}C for 20 minutes. After that blanching process was done to remove the skin of peanut. Peanuts were then grinded into smaller size. After roasting process, the brownish kernel and peanut were blended by using blender (i.e. Bakers, Malaysia) from low speed to high speed for 3 to 5 minutes until smooth texture. Ingredients such as salt and vegetable oil were added and the blending process was continued until a consistence spreads are produced. The spreads produced were stored inside the bottles. The formulation of dabai kernel spreads production was shown in Table 1 below.

Table 1. Formulation of Control and Dabai Kernel Spread

Ingredients	Level of incorporation			
	Control	Formulation 1	Formulation 2	Formulation 3
Peanut (g)	100	75	50	35
Dabai kernel (g)	0	35	50	75
Salt (g)	50	50	50	50
Oil (ml)	25	25	25	25

Proximate Analysis

The spread produced from the dabai kernel was subjected to proximate analysis to study the parameters such as moisture content, ash content, crude protein, crude fat, crude fibre, carbohydrate content and energy content by using AOAC methods [5]

Sensory Evaluation

The sensory test was carried out on the samples within 24 hours after dabai kernel spread produced. Hedonic test was used to measure the preference of the panellists towards the dabai kernel spreads in terms of the sensory properties such as colour, aroma, texture, spreadability, taste and purchase intention. Hedonic scale starting with 1 until 9 was representing dislike extremely until like extremely. Sensory test was conducted on 30 untrained panellists including undergraduate students and staff from University of Technology Sarawak. Sensory evaluation was conducted by providing plain biscuits, dabai kernel spreads and deionized water for the panellists.

Statistical Analysis

All the data collected were analysed by using SPSS Version 23 (Statistical Package for the Social Science, IBM: United States). Complete block one-way analysis of variance (ANOVA) was used to determine the significance difference of the mean values. The Tukey's test was adapted to determine if there was any significance different at the level of p-value less than 0.05.

RESULTS AND DISCUSSION

Moisture Content

Percentage moisture content of control and formula 2; formula 1 and formula 3 were not significantly different ($p>0.05$) form one another, yet, significantly different ($p<0.05$) from others. From the study, control showed the highest moisture content of 3.2% followed by formula 2 with moisture of 2.87%. The moisture percentage of control was lower than the value of 6.23% reported [6]. The results in Table 2 showed that, the incorporation of 25% dabai kernel into the peanut butter resulted in significant decreases ($p<0.05$) in moisture content of spread from 3.20% to 2.37%. The results of the study indicated that the moisture content of the spreads were within the range of peanut butter (1.23% - 4.17%) reported [7].

Formula 4 showed the lower moisture content of 1.53% compared to control and the other three formulations. By other study, raw dabai kernel has moisture content ranged from 27.09% to 45.38% [8]. Formula 4 which is 100% dabai spread contains lower moisture compared to raw dabai kernel. This may be due to the adding of solutes such as salt to the spread. Addition of solutes such as salt and sugar can help in reducing water content of foods [9]. The moisture difference of the spreads and the raw materials can be explained by the drying and roasting process which contributes to moisture lost. This explanation

can be supported by another report stating that roasting process caused decreases in moisture content of peanut butter [10].

Ash Content

Ash content of the dabai kernel spread in all of the formulations are increased not significant ($p>0.05$) from one another (Table 2). Ash content is interrelated with mineral content presents in food and these mineral will not be destructed by heat [11]. From the result, formula 2 showed the highest ash content of 5.82%, followed by formula 3 and formula 1 with value of 5.61% and 5.50% respectively. Control showed the lowest ash content of 4.67%. Previously reported that raw dabai kernel has ash content ranged from 2.24% to 2.84% [8]. Formula 4 with 100% dabai kernel contained higher ash content of 4.86% compared to raw kernel. This could be due to the results of salt presence which contributes as mineral content in the spread as reported before [4].

Protein Content

In the aspects of protein, protein content of dabai kernel spreads incorporated with peanut decreased as the amount of dabai kernel addition increases. Protein content of dabai kernel spreads showed highest in formula 4 with percentage of 28.58% followed by control with protein content of 26.55% and formula 1 of 25.67% (Table 2). Formula 2 and 3 were not significant difference ($p>0.05$) from one another with protein content of 23.92% and 23.33% respectively. From the results, the spreads showed to have the similar range value of protein content with peanut butter incorporated with ginger and crayfish (25.50% - 31.98%) reported by [6]. This range of the protein was complied with Food Regulation (1985) which stated that protein of a nut butter should more than 20%. Protein content of control is slightly higher than the raw peanut with protein content of 25.8% reported previously. Yet, this is opposed with [12] who reported that the protein content of raw peanut will be decreased when it is being roasted. Previous studies reported that protein content in raw dabai kernel is within the rage of 7.33% to 11.61% [8].

Fat Content

Fat is the major constituents of the composite sample spreads. From the results, the fat content of the spreads ranged from 42.58% to 49.03%. Formula 4 showed the highest fat content of 49.03%, followed by control (47.37%) and formula 2 (47.28%) (Table 2). Control and formula 2 showed no significant difference ($p>0.05$) among one another. This data recorded was closed to the fat content of cashew nut butter (47.60% to 52.92%) as reported by [13], except for formula 3 which had lowest fat content of 42.58%. The result is also similar to the value 47% for fat content of peanut butter as reported by United States Department of Agriculture [14]. Besides, the data recorded also conformed to Food Regulation (1985) which stated that peanut butter shall contain no more that 55% of fat content. Fat content in the dabai kernel spreads showed a decreasing trend with the increasing of the amount of dabai kernel as proven by [8] stating lipid content in raw dabai kernel ranges from 23.64% – 33.13%.

Crude Fibre Content

From the result of crude fibre, there was no significant difference ($p<0.05$) in the fibre contents of all of the samples. Crude fibre of the dabai kernel spread decreases when the amount of dabai incorporated into the samples increases. Formula 4 has the highest fibre content of 5.47% while Formula 3 had the lowest content of 5.00% (Table 2). The low content of crude fibre might be due to the low cellulose content of the peanut and dabai kernel as reported by [15] that cellulose content of a nut can affect the crude fibre content. Fibre content of the spreads ranged from 5.00% to 5.47% was similar to the fibre content of peanut butter (5.00% - 5.63%) as reported by [7]. This average results of 5% of fibre content indicates the ability of the table spread to maintain a good intestinal tract condition [7]. According to Food Regulation

(1985) and Food Standards Agency (FSA, 2007), foods which consists of more than 3% of fibre can be claimed as a source of fibre. Raw dabai kernel possess fibre ranged from 9.28% to 22.98% [8].

Carbohydrate Content

Carbohydrate content in the spread was closely related with the content of moisture, ash, protein and fat. Carbohydrate content of the spreads showed no significant difference ($p>0.05$) among each other. From the result, carbohydrate content of the spread ranged from 19.84% to 23.92%. Formula 3 showed the highest carbohydrates content while formula 1 showed the lowest. When amount of dabai kernel incorporated with the peanut increased, the content of carbohydrates increased from 19.84% to 23.92%. The range of the carbohydrate content in the results were within the range of peanut butter (20% - 32%) as reported by [5]. According to [8], raw dabai kernel has carbohydrate content ranged from 14.91% to 36.49% depending on the genotypes. From the result, formula 4 which is 100% dabai kernel had carbohydrate content of 22.52% within the ranged of raw dabai kernel.

Table 2. Proximate Composition for Different Formulation of Dabai Kernel Spread

Sample	Moisture (%)	Dry Matter (%)	Ash (%)	Protein (%)	Fat (%)	Crude Fibre (%)	Carbohydrate (%)
Control	$3.20^{a} \pm 0.20$	$96.80^{b} \pm 0.20$	$4.67^{a} \pm 0.60$	$26.55^{ab} \pm 1.34$	$47.37^{ab} \pm 0.52$	$5.33^{a} \pm 0.60$	$21.40^{a} \pm 1.87$
Formula 1	$2.37^{c} \pm 0.30$	$97.63^{c} \pm 0.30$	$5.50^{a} \pm 1.20$	$25.67^{ab} \pm 1.34$	$47.12^{a} \pm 0.78$	$5.15^{a} \pm 0.28$	$19.84^{a} \pm 1.30$
Formula 2	$2.87^{a} \pm 0.06$	$97.13^{a} \pm 0.06$	$5.82^{a} \pm 1.16$	$23.92^{a} \pm 1.34$	$47.28^{ab} \pm 0.86$	$5.15^{a} \pm 0.28$	$21.24^{a} \pm 2.21$
Formula 3	$2.43^{c} \pm 0.11$	$97.57^{c} \pm 0.11$	$5.61^{a} \pm 0.80$	$23.33^{a} \pm 2.20$	$42.58^{d} \pm 0.93$	$5.00^{a} \pm 0.00$	$23.92^{a} \pm 2.28$
Formula 4	$1.53^{d} \pm 0.11$	$98.47^{d} \pm 0.11$	$4.86^{a} \pm 1.00$	$28.58^{b} \pm 2.20$	$49.03^{bc} \pm 0.87$	$5.47^{a} \pm 0.50$	$22.52^{a} \pm 3.08$

Data are means ± standard deviation of triplicate analyses based on dry weight basis (w/w). Means values within the column with different letters are significantly different at $p < 0.05$.

Energy Content

Energy content of dabai kernel spreads were showed in Table 3. From the results, energy content of the spreads showed significant difference ($p<0.05$) among one another. Formula 1 and formula 2 showed no significant difference ($p>0.05$) respectively. Energy content of the spreads showed a trend of decreases when the amount of dabai kernel increased. Formula 3 showed the lowest energy content of 590.66% while formula 4 had the highest energy content of 625.92%. Perhaps the comparatively highest energy content values are due to the highest value of the protein and fat content quality as proven in Table 2 [7].

Table 3. Energy Content for Different Formulations of Dabai Kernel Spread.

Sample	Energy Content (kcal/100g)
Control	$617.85^{a} \pm 17.56$
Formula 1	$613.47^{b} \pm 14.27$
Formula 2	$613.06^{b} \pm 21.94$
Formula 3	$590.66^{d} \pm 22.89$
Formula 4	$625.92^{e} \pm 29.01$

Data are means ± standard deviation of triplicate analyses based on dry weight basis (w/w). Means values within the column with different letters are significantly different at $p < 0.05$.

Sensory Evaluation

The result of sensory evaluation of dabai kernel spread with different formulation and the purchase intention of the panellists were demonstrated in Figure 2. In terms of colour, formula 2 (50% dabai kernel, 50% peanut) showed the highest preference with a mean value of 7.58. This is then followed by formula 1 (25% dabai kernel, 75% peanut) and control (100% peanut) with mean score of 6.87 and 6.83 respectively. Formula 4 (100% dabai kernel) had the lowest mean score of 4.10. This could be due to the undesirable dark brown colour appeared in formula 4. From the result, there was a relatively significant difference ($p < 0.05$) between the colour of formula 2 and formula 4. However, there was no significant difference between the preferences of control, formula 1 and formula 3. Thus, it can be concluded that, with regard to colour, an increases of dabai kernel in the spread may provide undesirable colour attribute.

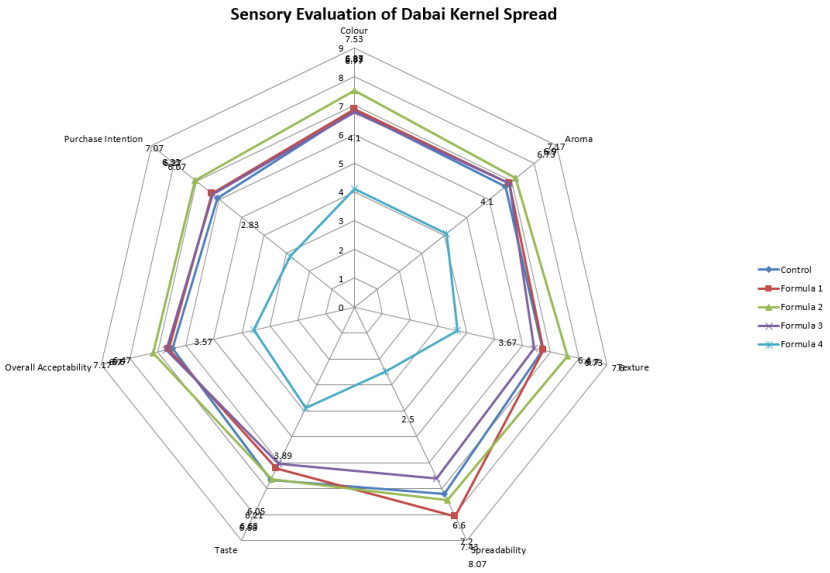

Figure 2. Sensory Evaluation Chart of Dabai Kernel Spread

Similar to aroma, a significant difference ($p < 0.05$) was observed between formula 4 (100% dabai kernel) with all of the dabai kernel spread sample. Contrastly, there was no significant difference ($p > 0.05$) between control, formula 1 and formula 3, meaning that, control is preferred as much as the formula 1 and 3. Formula 2 had the highest mean score of 7.17, followed by formula 1 and 3 which had the same mean value of 6.90. Besides, formula 4 had the lowest mean score of 4.10. From the result, it can be concluded that formula 2 with 50% dabai kernel and 50% peanut was the most preferable spread in terms of aroma of the panellists.

In terms of texture attribute, there was a significant difference ($p < 0.05$) between formula 2 and formula 4. Generally, texture of the spread is about the smoothness or the mouth-feel of the sample. According to the result, it can be observed that formula 2 had the highest texture with mean score of 7.60, followed by formula 1 with mean score 6.73. The lowest texture score was formula 4 which is 3.67. The smoothness of the spread in formula 4 is lower and drier than the other formula. From the result, it can be concluded that, with the increases of dabai kernel, the texture will be lower. The highest texture in formula 2 means that it was the most preferable sample of the panellists among all the samples.

For the spreadability attribute, there was a significant difference ($p < 0.05$) between formula 1, formula 3 and formula 4. From the result, formula 1 (25% dabai kernel, 75% peanut) had the highest mean score of 8.07. This was then followed by formula 2 (50% dabai kernel, 50% peanut) with value of 7.43 and control (100% peanut) with score of 7.20. Formula 4 (100% dabai kernel) had the least score of 2.50. Poor texture properties in formula 4 can influence the spreadability of the spread. Sample with higher amount of dabai kernel contributes to lower spreadability and thus, the spreadability value decreased. Spreadability is one of the important criteria in a nut spread, thus, a smooth texture with high spreadability spread help to avoid the tearing of the bread [13].

For taste attributes, formula 4 had the lower mean score of 3.89 while control had the highest taste score of 6.68. This is then followed by formula 2 and formula 1 with mean score of 6.63 and 6.21 respectively. Among these, there was a significance difference ($p < 0.05$) between formula 4 and all of the other sample. Those sample that showed no significant difference ($p > 0.05$) might indicated that the panellist could not detect any difference in term of taste among the spreads as reported [16]. With regard to overall acceptability, there was a significant difference ($p > 0.05$) between formula 2 and all the other samples. Overall acceptability was observed highest in formula 2 with mean score of 7.17, followed by formula 3 and formula 1 with mean score of 6.70 and 6.60 respectively. Similar with other sensory properties, formula 4 had the least score of overall acceptability of 3.57. Most of the panellists accepted formula 2 which is 50% dabai kernel and 50% peanut.

For purchase intention, formula 2 showed the highest mean score of 7.07, meaning that most of the panellists have the willingness to purchase product made from this formulation. This was then followed by formula 1 and formula 3 with mean score of 6.33 and 6.27 respectively while the least score was formula 4 of 2.83. Thus, there was a significant difference ($p < 0.05$) between formula 4 and all of the other samples.

CONCLUSION

This research highlights on the feasibility of dabai kernels to be develop into table spread. Dabai kernels extracted from dabai seeds waste contains a good source of starch and protein, and has the potential to be converted into a value added product such as spread. For future research, antioxidant activity and microbial study shall be considered to improve the formulation of dabai kernel spread.

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