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Effects of brown rice powder addition on nutritional composition and acceptability of two selected Malaysian traditional rice-based local *kuih*

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Abstract

The present study was conducted to investigate the effects of brown rice (BR) powder addition on the proximate composition, total dietary fibre content and acceptability of some selected Malaysian traditional rice-based local *kuih*. Two types of *kuih* samples, namely *Kuih Lompang (KL)* and *Kuih Talam Pandan (KTP)* were prepared at the levels of either 0%, 10%, 20% or 30%. The *kuih* samples were analyzed for nutritional composition and sensory acceptance. There was significant increase in total dietary fibre content (from 2.64 g/100 g to 3.15 g/100 g) and protein content (from 2.36% to 2.51%) with the incorporation of 90% BR powder in the KL formulation. The moisture (from 36.79% to 36.83%), ash (from 1.11% to 1.21%) and fat (from 8.51% to 8.73%) content were not significantly affected for all percentages of BR powder addition. For KTP, the addition of BR powder at the level of 90% significantly increased the total dietary fibre (from 2.77 g/100 g to 3.45 g/100 g), fat (from 5.73% to 6.95%) and moisture (from 64.10% to 64.12%) content as compared to the control (0%). However, the protein content was not significantly affected (from 3.41% to 3.59%). On the other hand, there was no significant difference for all sensory attributes of KL formulated with 30-90% of BR powder as compared to the control (0%). The sensory score of KTP added with 30-90% BR powder received significantly lower sensory score compared to the control sample (0%) for appearance, colour, firmness, adhesiveness, chewiness, taste and overall acceptance attributes. In summary, sensory evaluation showed that all BR-incorporated KL were acceptable, while only 30% addition of BR powder in KTP was acceptable. Thus, BR powder is potentially used in improving the nutritional composition of KL. However, further study is needed to improve palatability aspect of KTP formulated with BR powder.

Introduction

Presently, Malaysians are not consuming enough of fruits and vegetables compared to their consumption of other staple foods such as meat and rice (Yen and Tan, 2011). Inadequate intake of vegetable and fruit will lead to imbalance diet among the Malaysians which will increase the risk of non-communicable diseases (NCDs). Functional diets have gained a lot of attention for their promising role in the prevention of non-communicable diseases with an increasing realization of the role of diet in the pathogenesis of certain chronic diseases. The consumption of brown rice (BR), which is one of the functional foods, is gaining appreciation among health conscious individuals due to its better nutritive value compared to polished rice or white rice (Hagiwara *et al*., 2004).

Several studies have indicated that it is better to eat unpolished (brown) rice. This is because the outer bran layer of the rice grain, which is removed during the milling process, is rich in fiber, iron, vitamins and minerals (Patil and Khan, 2011). Their removal causes the loss of nutrients, especially B vitamins where the thiamin content of rice is reduced by over 80% after polishing the rice. BR contains more, nutritional components such as dietary fibers, phytic acid E and B vitamins and γ-aminobutyric acid (GABA) compared to the white rice (WR) due to the presence of outer bran layer being the main source for the nutritional elements (Ohtsubo *et al*., 2005).

In addition, brown rice has been reported to have therapeutic effects like hypocholesterolemia, improvement of low density lipoprotein (LDL) cholesterol level and preventing type 2 diabetes mellitus (Most *et al*., 2005; Sun *et al*., 2010; Lai *et al*., 2012) because of its constituents. Although BR is more nutritious than WR, its intake is somewhat limited by the chewy texture and reduced digestibility and also less preferred by rice consumer due to its taste, colour, price, tradition, brand preference, dietary habits and availability (Zhang *et al*., 2010). Anyway, the change of staple food from polished rice to brown rice is expected to maintain and promote the healthy life and improve the quality of life (Hiroshi,

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2005). The recommendation for dietary fiber intake range from 25 g to 38 g dietary fiber per day or 14 g dietary fiber/1,000 kcal (Slavin, 2008). Meanwhile, a cup of brown rice adds nearly 3.5 g of fiber per day, while an equal amount of white rice not even 1 g of fiber per day (Kuriyan *et al*., 2005; Most *et al.*, 2005).

As living standard is elevated, people tend to consume more highly refined foods such as WR because of their perceived improved palatability and for convenience of preservation and transportation. Most rice is consumed as polished rice. In Malaysia, low consumption of BR is supported by a study on the Malaysian's preferences for rice which found out that the demand of consumer for regular rice which is organic and long grain is more than BR. This may be related to the more expensive price as well as the lower familiarity to the BR. As the result of lower popularity of BR among the Malaysians, more comprehensive investigation on the incorporation of BR into varieties of food products such as bread, biscuits, and popular traditional local cakes which is greatly accepted by the Malaysians should be conducted to increase their BR intake which brings a lot of health benefits to them (Ahmad Hanis *et al*., 2012).

Based on findings from Malaysian Adult Nutrition Survey (MANS), local kuih are in the top 10 list of daily consumed foods among Malaysians (Norimah *et al.*, 2008). The prevalence of those who consumed local kuih daily was 16.30%, while the mean frequency of consumption per day for men and women was 1.1 and 1.2 respectively. The average amount of kuih consumed daily by them was two pieces per day.

Kuih lompang and *kuih talam pandan* are examples of local kuih frequently consumed in Kelantan, Malaysia. According to the traditional recipe of these *kuih,* they are mainly made from ingredients which are high in carbohydrates and low in dietary fiber, minerals and vitamins contents such as rice flour, coconut milk *(santan)*, sugar, salt and so on (Chang, 2012). Accordingly, these traditional local kuih properly formulated with high nutritional and sensory qualities, has the potential of being a source of essential nutrients especially for children and teenagers and other communities in Malaysia. The present study aims to investigate the effects of BR powder addition on nutritional composition and acceptability of some selected Malaysian traditional rice-based local *kuih.*

Materials and Methods

Preparation of Kuih Lompang formulated with BR flour

The BR powder was purchased from local supermarket located at Kota Bharu city, Kelantan, Malaysia. Other ingredients were purchased from local suppliers. Palm sugar, table sugar, water and screwpine leaves were combined in a saucepan and then brought to a slow boil while stirring continuously until all sugars dissolved completely. After that, the syrup was strained and removed the screwpine leaves. Following that, the WR flour and tapioca flour were sifted into a large mixing bowl. Then, water and alkaline water were added into the bowl and stirred well until it was smooth. The strained hot palm sugar syrup was pour into the flour mixture and stirred until it was evenly blended and free from lumps. After that, small Chinese teacups were arranged in a steamer and the teacups were heated for about 6 to 7 minutes. Next, the batter was poured into the teacups, filling to almost three quarters full. After steamed for 8 to 10 minutes, the KL were removed and left to cool completely while waiting for further analyses. All the procedures above were repeated for all formulations of BR powder to replace WR at different percentage (0%, 30%, 60% and 90% of BR powder). Partial of the WR flour were substituted with BR powder (BRP) at the level of 0% (0BRP:100WRF), 30% (30BRP:70WRF), 60% (60BRP:40WRF) and 90% (90BRP: 10WRF). Then, *Kuih Lompang* formulated with different levels of BR powder was analyzed.

Preparation of Kuih Talam Pandan formulated with BR flour

The screwpine juice was produced by taking 10 blades of screwpine leaves and then adding in 200 g water. After blending them together, they were strained to produce screwpine juice. For the green layer, the rice flour, tapioca flour, green pea flour and sugar were mixed together and then stirred in screwpine juice. Then, the mixture was poured into a saucepan and cooked over low heat until mixture slightly thickens. After that, the mixture was poured into an 8 inch greased mould and steamed for about 20 to 25 minutes until set. For the white layer, rice flour, tapioca flour, green pea flour, salt, coconut milk and water were combined and stirred together in a bowl. Following that, the mixture was cooked over low heat until mixture thickened about 8 minutes. After that, the coconut layer was poured onto the green screwpine layer after removed the green layer from the heat. Then, both layers were steamed for another 15 minutes. Finally, the KTP was removed from the

steamer and it was left cool for at least 4 hours prior to cutting. All the procedures above were repeated for all formulations of BR powder (0%, 10%, 20% and 30%). Partial of WR powder were substituted with BR powder at the level of 0% (0BRP:100WRF), 30% (30BRP:70WRF), 60% (60BRP:40WRF) and 90% (90BRP: 10WRF). Then, KTP formulated with different levels of BR powder was analyzed.

Preparation of sample for nutrient analyses

After developing the *kuih*, they were cooled to room temperature and oven-dried for moisture analysis. Then, dried kuih were ground into powder form using electrical grinder (Warring brand, 8010S model) and kept in Duran bottle for various analyses as described below.

Proximate compositions and total dietary fibre (TDF) Analysis

Proximate analysis were conducted using AOAC (2000) for moisture (Air-oven method), total ash, crude protein by nitrogen conversion factor of 6.25 (Kjeldahl method) and crude fat content using the semi-continuous extraction (Soxhlet method). TDF was determined by enzymatic gravimetric method, based on the AOAC (2000). All measurements were carried out in triplicate (n = 3).

Sensory evaluation

Sensory evaluation of both types of kuih was carried out by 60 untrained consumers consisting of students and staffs of the School of Health Sciences, Universiti Sains Malaysia Health Campus. Consumers received 4 different formulations of Kuih Lompang and Kuih Talam Pandan for sensory test. Approximately 2 cm x 2 cm of uniform sliced kuih were presented to them. The tested samples were coded with 3 digits permuted number. All samples were evaluated according to the 7-hedonic scaling method. Sensory parameters evaluated were appearance, color, firmness, adhesiveness, chewiness, taste and overall acceptance on a 7 point scale (1 = dislike the most and 7 = like the most).

Data analysis

Data were analyzed according to one-way ANOVA procedure by using SPSS 18.0 (USA). One way ANOVA coupled with Tukey's post-hoc test was used. Results were expressed as mean ± standard deviation. All measurements were carried out in triplicate (n = 3). Significant level was established at $P<0.05$.

Results and Discussion

Proximate composition and TDF content of KL

Table 2 shows the proximate composition and TDF contents of KL incorporated with four different percentages of BR powder. Among all proximate composition, only protein was significantly higher in KL incorporated with 90% BR powder (2.51%) compared to the control (2.36%). Meanwhile, there were no significant differences ($P>0.05$) in the moisture (36.79-37.45%), ash (1.09-1.21%) and fat (8.34-8.73%) content of KL added with 30%, 60% and 90% of BR powder. The significant increase ($P<0.05$) in the protein content with 90% BR powder incorporation was in line with the findings from other studies. According to Rosniyana *et al.* (2011), the addition of stabilized rice bran in *Kuih Baulu* significantly increased the protein content of *Kuih Baulu.* Besides that, the study done by Wan Rosli and Che Anis (2012) also showed that the addition of 10% to 30% of young corn powder into the cookies significantly increased the protein content. This is due to the fact that the BR had been reported to have higher protein content (4.88g) than the WR which has 4.10g of protein content (Babu *et al*., 2009).

Moisture content from the present study showed insignificant different between all treatments of KL. This finding was different from other study which exhibited significant increase in the moisture content following the stabilized rice bran incorporation into the *Kuih Baulu* at the levels of 10% to 40% (Rosniyana *et al*., 2011). Besides that, there was significant increment in the moisture content with the addition of YCP in the bread (Lim and Wan Rosli, 2012), cheonnyuncho powder in the sponge cakes (Kim *et al*., 2012), green tea in sponge cake (Lu *et al.*, 2010) and the nutrim oat bran in shortened cake (Dadkhah *et al*., 2012).

In addition, there was no significant difference ($P>0.05$) in the ash content between KL incorporated with 30%, 60%, 90% of BR powder and the control (0%). The present findings indicated that the incorporation of BRP do not have significant effect on the ash content which represents the mineral content of certain food or food product. This may be because the chemical compositions of BR powder are affected by the preparation procedure during the processing of BR powder. Moreover, the ash content may also be affected by the quality of flour in which the flour of higher quality has higher mineral content especially potassium (Kim, 1996).

For fat content, there was no significant difference ($P>0.05$) observed between any percentages of BR powder in the KL sample. This finding was in line with

Table 1. *Kuih Lompang* formulated with different levels of brown rice powder (BRP)

Items	Ingredients	Quantities/ Weight			
		Control (0% BRP)	30% BRP	60% BRP	90% BRP
1	Rice Flour	100g	70g	40g	10g
2	Tapioca Flour	70g	70g	70g	70g
3	Water	340 ml	340 ml	340 ml	340 ml
4	Alkaline water	¼ tsp	¼ tsp	¼ tsp	¼ tsp
5	Palm sugar	250g	250g	250g	250g
6	Table Sugar	50g	50g	50g	50g
7	Screwpine leaves	2 blades	2 blades	2 blades	2 blades
8	Grated coconut	100g	100g	100g	100g
9	Salt	½ tsp	½ tsp	½ tsp	½ tsp
10	BRP	0g	30g	60g	90g

Note. Modified from Chang (2012)

Table 2. Proximate compositions and total dietary fibre (TDF) content of *Kuih Lompang* added with BRP

BRP Level	0%	30%	60%	90%
Moisture	36.79 ± 0.23^{a}	36.81 ± 0.30^{a}	37.45 ± 0.22^{a}	36.83 ± 0.84^{a}
Ash	1.11 ± 0.08^{a}	1.14 ± 0.03^{a}	1.09 ± 0.13^{a}	1.21 ± 0.07^{a}
Fat	8.51 ± 0.10^{a}	8.47 ± 0.66^{a}	8.34 ± 0.09^{a}	8.73 ± 0.12^{a}
Protein	2.36 ± 0.03^{c}	2.37 ± 0.10^{bc}	2.47 ± 0.04^{ab}	2.51 ± 0.01^{a}
TDF	2.64 ± 0.10^{c}	2.81 ± 0.10^{bc}	2.98 ± 0.10^{ab}	3.15 ± 0.10^{a}
Carbohydrate	51.23 ± 0.15^{a}	48.40 ± 0.20^{b}	47.67 ± 0.18^{c}	47.57 ± 0.25^{c}

[a-c] Mean values within the same row bearing different superscripts differed statistically ($P<0.05$)

a study carried out by Kim and his colleagues (2012). There was no significant difference in the fat content of sponge cake incorporated with Cheonnyuncho at the levels of 3% to 9% as compared to the control (Kim *et al*., 2012). However, the finding from other study was contradict with the present study. For instance, there was significant increase in the fat content in *Kuih Baulu* added with 20% to 40% of stabilized rice bran (Rosniyana *et al*., 2011) as compared to the control.

Apart from that, the total dietary fibre content of KL formulated with 90% of BR powder (3.15%) was significantly increased compared to the control (2.64%). This finding was in line with a number of studies that showed that the incorporation of ingredients rich in fiber would lead to an increase in the total dietary fibre content of the food products studied. For example, addition of sunflower seeds powder in cake (Salem *et al*., 2012), matured green banana flour and oat β-glucan in noodles (Chong and Noor Aziah, 2010), orange bagasse product in bakery products (Romero-Lopez *et al*., 2011), mango peels in biscuit (Ajila *et al*., 2008) and soy bean flour in breads (Ndife *et al*., 2011). This is due to the fact that there is higher dietary fiber content in the brown rice (3.32 g) as compared to white rice which has 0.74 g of dietary fiber (Babu *et al*., 2009), thus improving the nutritional quality of KL.

Proximate composition and TDF content of KTP

Table 3 shows that among these proximate compositions of KTP, there was significantly ($P<0.05$) higher moisture content of KTP added with BR powder (64.12-65.75%) powder when it was compared to the control (64.10%). This finding was quite similar to the study done by Rosniyana *et al*., 2011. Furthermore, this finding was slightly similar to the study conducted by Lim and Wan Rosli (2012) which showed that addition of 2%, 4% and 6% of young corn powder (YCP) into the bread increased the moisture content significantly. According to Skurray *et al*. (1988), the water absorption increased with higher amount of rice bran in BR powder which might be due to the increase in absorption rate of water during mixing of dough. The free hydroxyl groups of the cellulose and hemicelluloses bound with water molecules contributed to a greater water holding capacity (Sangnark and Noomhorm, 2003). Thus, there will be higher water absorption with increasing levels of BR powder and this contributed to higher moisture content.

In addition to that, there was a significant increase in the fat content of KTP incorporated with BR powder ranging from 6.86-6.95% as compared to the control (5.73%). This may due to the slightly higher fat content in BR (1.17 g) compared to polished rice (0.205 g) (Babu *et al*., 2009). Furthermore, there was insignificant ($P>0.05$) increment in the protein content of KTP incorporated with 60% and 90% BR powder which range from 3.54-3.59% as compared to the control kuih (3.41%). The slight increase in the protein content may be due to the slightly higher protein content in the brown rice (4.88 g) compared to the protein content in the white rice (4.10 g) (Babu

Table 3. Proximate compositions and total dietary fibre (TDF) content of *Kuih Talam Pandan* added with BRP

BRP Level	0%	30%	60%	90%
Moisture	64.10 ± 0.40^{b}	65.46 ± 3.75^{a}	65.75 ± 1.16^{a}	64.12 ± 0.60^{a}
Ash	1.83 ± 0.14^{a}	1.40 ± 0.02^{b}	1.22 ± 0.02^{c}	1.77 ± 0.02^{c}
Fat	5.73 ± 0.04^{b}	6.86 ± 0.13^{a}	6.90 ± 0.04^{a}	6.95 ± 0.02^{a}
Protein	3.41 ± 0.20^{a}	3.20 ± 0.11^{a}	3.54 ± 0.07^{a}	3.59 ± 0.03^{a}
TDF	2.77 ± 0.10^{d}	3.00 ± 0.10^{c}	3.22 ± 0.10^{b}	3.45 ± 0.10^{a}
Carbohydrate	24.93 ± 0.10^{a}	23.08 ± 0.22^{b}	22.59 ± 0.28^{b}	23.57 ± 0.21^{b}

$^{a-c}$ Mean values in the same row bearing different superscripts differed statistically (P<0.05)

Table 4. Sensory acceptability of *Kuih Lompang* added with BRP (N=60)

BRP Level	0%	30%	60%	90%
Appearance	4.73 ± 1.48^{a}	4.63 ± 1.19^{a}	4.72 ± 1.18^{a}	4.58 ± 1.42^{a}
Colour	4.58 ± 1.52^{a}	4.55 ± 1.16^{a}	4.63 ± 1.15^{a}	4.60 ± 1.48^{a}
Firmness	4.43 ± 1.45^{a}	4.57 ± 1.13^{a}	4.33 ± 1.34^{a}	4.38 ± 1.29^{a}
Adhesiveness	4.10 ± 1.57^{a}	4.57 ± 0.93^{a}	4.43 ± 1.41^{a}	4.55 ± 1.41^{a}
Chewiness	4.43 ± 1.54^{a}	4.58 ± 1.08^{a}	4.33 ± 1.36^{a}	4.50 ± 1.42^{a}
Taste	4.38 ± 1.53^{a}	4.55 ± 1.08^{a}	4.40 ± 1.26^{a}	4.38 ± 1.34^{a}
Overall Acceptance	4.47 ± 1.33^{a}	4.70 ± 1.03^{a}	4.40 ± 1.24^{a}	4.45 ± 1.29^{a}

^{a} Mean values within the same row bearing different superscripts differed statistically (P<0.05)

et al., 2009).

On the other hand, the ash content decreased significantly (P>0.05) in the KTP incorporated with BR powder ranging from 1.17-1.40% as compared to the control (1.83%). The decrease in the ash content may indicate that the chemical composition of the BR powder was affected by the preparation procedure during processing of BR powder. Besides that, the ash content may also be affected by the quality of flour in which flour of higher quality has higher mineral content especially potassium (Kim, 1996).

Meanwhile, the incorporation of higher levels of BR powder in KTP showed that there is an increase in the total dietary fibre (TDF) content proportionally. Compared to the control (2.77%), the TDF of the samples with 90% of BR powder was significantly increased (3.45%). The findings of the present study was in line with a few studies that exhibited that the incorporation of fibre-rich ingredients such as matured green banana flour and oat β-glucan (Chong and Noor Aziah, 2010), orange bagasse product (Romero-Lopez *et al*., 2011), mango peels (Ajila *et al*., 2008) and soy bean flour (Ndife *et al.*, 2011) would lead to an increase in the TDF content of the food products studied. The significant increase in the TDF in KTP added with 90% of BR powder was due to higher dietary fiber content in the BR (3.32 g) as compared to WR which has 0.74 g of dietary fiber (Babu *et al.*, 2009). This finding indicated that BR powder could be used as a potential source of dietary fibre that is essential for maintaining a good health as a lack of fibre in the diet has been associated with constipation, diverticulitis, diabetes, obesity, cardiovascular disease, and cancer (Marlett *et al.*, 2002).

Sensory attributes of Kuih Lompang (KL)

Table 4 shows the scores of all the sensory attributes of KL formulated with 0%, 30%, 60% and 90% of BR powder. There was no significant difference (P<0.05) in the score for all sensory attributes with all treatments. The results of sensory evaluation showed that the panelists preferred KL incorporated with 30% of BR powder which has the highest score (4.70) in overall acceptance and other sensory attributes such as firmness (4.57), adhesiveness (4.57), chewiness (4.58) as well as taste (4.55) in comparison to all other KL samples. Nonetheless, the KL incorporated with 60% of BR powder scored the highest value for colour attributes (4.63) whereas the control recorded the highest score for appearance (4.73).

This finding indicated that the addition of BR powder not more than 30% into KL formulation, may enhance its texture properties. It could be believe that the addition of at higher levels BR powder did not affected the colour of the *kuih* although the rice bran normally present in the BR has light tan colour which may contribute to the colour of KL (Bor *et al.*, 1991). This may be due to the colour of BR powder was masked by the presence of palm sugar that give the dark brown color to the KL. In addition, the KL incorporated with 30% BR powder has the highest score (4.55) for the taste attribute. The rice bran

Table 5. Sensory acceptability of *Kuih Talam Pandan* added with BRP (N= 60)

BRP Level	0%	30%	60%	90%
Appearance	6.02 ± 0.93[a]	4.55 ± 1.03[b]	3.02 ± 1.31[c]	2.83 ± 1.39[c]
Colour	6.07 ± 0.90[a]	4.55 ± 1.08[b]	3.05 ± 1.28[c]	2.72 ± 1.32[c]
Firmness	5.13 ± 1.16[a]	4.30 ± 1.09[b]	3.85 ± 1.27[c]	4.18 ± 1.19[b,c]
Adhesiveness	4.88 ± 1.30[a]	4.45 ± 1.14[b]	4.07 ± 1.19[b]	4.25 ± 1.14[b]
Chewiness	5.00 ± 1.33[a]	4.13 ± 1.19[b]	3.93 ± 1.29[b]	4.23 ± 1.20[b]
Taste	5.65 ± 1.23[a]	4.52 ± 1.08[b]	3.68 ± 1.41[c]	3.45 ± 1.45[c]
Overall Acceptance	5.55 ± 1.13[a]	4.48 ± 0.97[b]	3.78 ± 1.01[c]	3.58 ± 1.24[c]

[a-c] Mean values within the same row bearing different superscripts differed statistically ($P<0.05$)

present in the BR powder was described as having a slightly toasted and nutty flavor (Rosniyana *et al.*, 2005). The panelist may not favor the flavor caused by the rice bran in the BR powder when it is added more than 30% in the KL. The findings of the present study have indicated that the additions of BR powder at any levels did not affected the KL's acceptability of the panelist. Nevertheless, KL added with 30% of BR powder was the most acceptable kuih among the panelist.

Sensory attributes of Kuih Talam Pandan (KTP)

Table 5 shows all sensory attributes of KTP formulated with four different percentages of BR powder. The sensory results indicated that the control KTP had significantly ($P<0.05$) higher score for all of the sensory attributes such as appearance, colour, firmness, adhesiveness, chewiness and taste. Panelist indicated that the colour of KTP increased in darkness with BR powder incorporation from 30% to 90%. The highest score for colour attribute was obtained by the control KTP. The rice bran present in the BR powder which has light tan colour, may contribute to the colour of BR powder-incorporated KTP (Bor *et al*., 1991).

Besides, the sensory results indicated that panelist preferred the firmness, adhesiveness and chewiness attributes of the control (0%) than the KTP added with BR powder. This finding may indicated that the type of BR powder used in this study may not be appropriate for developing the KTP with desirable texture. The score of the taste attribute of the control KTP (0%) was significantly higher than KTP containing BR powder. The rice bran present in the BR powder had a sweet, slightly toasted, nutty flavor which may be the main contributing factor in affecting the taste of KTP (Rosniyana *et al.*, 2005). Besides that, the KTP incorporated with BR powder has a slightly bitter taste. The bitter taste may be due to excessive amount of screwpine juice in the green layer of KTP. In addition, the bitter taste was also presumably associated with saponin present in the rice bran found in BR powder (Rosniyana *et al.*, 2005). However, the amount of saponin in the products depends on the levels of BR powder in the formulation of the product.

The panelist preferred control (0%) which has the highest score (5.55) for the overall acceptability of KTP. Besides, the KTP added with 60% to 90% BR powder were considered not acceptable as they were rated 3.58 to 3.78 for overall acceptability. However, the KTP incorporated with 30% was rated 4.48 for overall acceptability which indicated that the BR powder should be added until 30% in KTP only. This finding was similar to other study where the addition of BR powder by-products such as rice bran was not acceptable at the levels above 30% in products such as kuih baulu (Rosniyana *et al*., 2011).

Generally, panel members preferred KTP without addition of BR powder which has the highest scores for all attributes values that ranged from 4.88 to 6.02. Apart from that, among KTP added with BR powder, the KTP with 30% BR powder was the most acceptable with the overall acceptance score of 4.48. This score dropped following increased percentage of BR powder added into the kuih.

Conclusion

The incorporation of BR powder was shown to be capable of increasing the protein content of the *Kuih Lompang* without affecting the moisture, ash and fat content as well as consumer's acceptability. Meanwhile, the moisture and fat content in the *Kuih Talam Pandan* increased, while the ash content decreased following the incorporation of BR powder without affecting its protein content. The incorporation of increasing levels of BR powder into the *Kuih Talam Pandan* decreased the sensory acceptability of this *kuih*. The highest percentage of BR powder in *Kuih Talam Pandan* acceptable by the panelists was 30%. Generally, the total dietary fibre content of *Kuih Lompang* and *Kuih Talam Pandan* increased in line with the percentages of

BR powder added. In conclusion, the addition of 30% of BR powder in both *Kuih Lompang* and *Kuih Talam Pandan* could be recommended as the ideal formulation of preparing a healthier traditional rice-based local *kuih* for the consumption of Malaysian populace. However, further study is needed to improve palatability aspect of *Kuih Talam Pandan* formulated with BR powder.

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