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Sensorial and nutritional properties of "*Pawa*" added with pigmented Rice (*Oryza sativa*)

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Abstract

The traditional rice delicacy *pawa* of Piat, Cagayan was modified by incorporating pigmented rice varieties particularly red and black rice varieties. The study aimed to determine the optimum level of substitution of pigmented rice flour in the manufacture of *pawa* and to determine the sensorial, nutritional and functional properties of the enriched rice-based product. *Pawa* samples were prepared by using 10%, 20%, 30%, 40%, and 50% of red and black rice flours. *Pawa* samples were evaluated by 25 panelists using quality scoring, specifically 7- point hedonic scale for the sensory attributes color, aroma, flavour, texture, and general acceptability. The following chemical composition moisture content (g/100g), protein content (g/100g), fat content (g/100g), ash content (g/100g), carbohydrate content (g/100g) and crude fiber (%) of the rice flours as well as the *pawa* samples were also determined. Based on the results, the general acceptability of *pawa* samples prepared with 10% and 20% black rice flour were significantly better than the other levels of substitution. *Pawa* samples with 20 to 30% red rice flour substitution, on the same way, were highly accepted by the panelists in terms of the products' overall acceptability. Substitution of up both black rice flour and red rice flour in the preparation of *pawa* also provided higher nutrition.

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Introduction

Rice (*Oryza sativa* L.) is the third major grain grown crop across the world and considered as the most widely consumed by almost half of the population of the world as staple food (Rathna Priya *et al.*, 2019). Rice exists in different kinds such as non-pigmented and pigmented varieties. The most available and common variety consumed by humans is the non-pigmented rice (Ling *et al.,* 2001). Due to the considerable amount of polyphenols, interest in the pigmented rice kernels is increasing (Chaudhary, 2003). The main polyphenols of purple to black rice and red rice are anthocyanins and pro-anthocyanins with beneficial properties *i.e.,* antioxidant, anti-inflammatory, cardioprotective and antiatherogenic activities (Wang *et al.,* 2007).

The Asian countries mostly consumed pigmented rice varieties (Deng *et al.*, 2013), because they have richer taste (Kushwaha, 2016), are nutritionally superior than white rice since they have higher content protein content, dietary fiber, some fatty acids, vitamins and minerals (Hu *et al.*, 2003). Compounds from pigmented rice extracts have diabetic preventive activities (Yawadio *et al.*, 2007); while Lee *et al. (*2008) demonstrated that black rice to be highly effective in lowering cholesterol levels in human body. In 2005, Meng *et al.* (2005) reported that black rice has higher manganese, calcium, minerals, iron, copper and zinc than those in other varieties. Due to nutritional and health-promoting characteristics of black rice, it has recently been recognized in super food and functional food categories (Suzuki *et al.*, 2004). On the same way, due to its excellent nutritional and functional properties red rice, has a high potential for a health-based food product, i.e. baby food production (Masni *et al.*, 2019). Also, the next biggest reservoir of phytochemicals after black rice is red rice (Pengkusri *et al.*, 2015). Because of these health values, pigmented varieties have been becoming popular as ingredient in development of pigmented rice-based food productsfor human consumption such as desserts and snacks (Tananuwong and Tewaruth, 2010). Several studies on the utilization of pigmented rice varieties were conducted. Inclusion of black rice powder in preparing cookies and biscuits resulted in a very strong flavor and texture that are acceptable (Klunklin and Savage, 2018). Additonally, cookies and biscuits can be added with black rice powder and can be used as a functional food for diabetic patients (Mazumdar *et al.*, 2022). A breakfast cereal with very appealing color, desirable expansion, and texture was also successfully manufactured through extrusion using black rice varieties (Meza *et al.*, 2019). Some value added products studied for red rice include production of cake, gluten-free bread, powder mixes, and yoghurt (Mazumdar *et al.*, 2022). The food industry is faced with ongoing issue on new food products develoipment with special health-enhancing characteristics, hence, utilization of functional ingredients like pigmented rice is needed to add value and enrich nutrition in food products (Lainumngen *et al.*, 2020).

In the Philippines, traditionally, in agricultural area, rice-based product is an industry (Ibaňez *et al.*, 2020). Rice, is not only consumed as staple food, but also considered as major ingredient in manufacturing value added food products such as puffed rice, noodles, rice flakes, extruded snacks, fillers for processed meats, low fat sauces, and in preparation of traditional delicacies, which is very common to Filipinos, such as rice cake (*kutsinta)*, (*puto*), *palitaw, bibingka*, *tikoy*, and *espasol* (Blase, 2020). Lot of indigenous recipes are being produced in some parts the country which serve as a source of livelihood for both non- farming and farming communities. In Cagayan Valley Region, rice-based producers cater to a number of rice delicacies patronized by different customers where 25 food products are being produced in Cagayan, 18 in Isabela, 10 in Nueva Vizcaya, and 13 in Quirino, and *puto*, *bibingka*, *suman*, *tinudok, tinupic*, , and *inatata* are mostly produced in all provinces (Ibaňez *et al.*, 2020).

"*Pawa*" is a bite-sized, soft-to-firm, chewy delicacy made from glutinous rice that originated in the Municipality of Piat, Cagayan, Philippines. This traditional delicacy is made popular because it is not only available in the kiosks and stalls around the famous Our Lady of Piat Basilica, but also this delicacy is sold by vendors to commuters from the municipality which can be eaten in the comfort of vehicles.

"*Pawa*" is mainly made of steamed glutinous rice buns stuffed with sweetened ground peanuts. The traditional "*pawa*" is white in color. To our knowledge, rare to none studies have been observed for the utilization pigmented rice varieties in the manufacture of traditional delicacies, particularly "*pawa*", thus this study. Through the development of this study, the linkage between Specialty Rice production and manufacturing sectors in the region may be strengthened and awareness on nutritional benefits will be raised among rice-based products producers and consumers.

In this study, the traditional rice delicacy *pawa* of Piat, Cagayan was modified by incorporating pigmented rice varieties particularly red and black rice varieties. The study aimed to determine the optimum level of substitution of pigmented rice flour in manufacture of *pawa* and to determine the sensorial, nutritional and functional properties of the enriched rice-based products.

Materials and methods

Raw Materials and Preparation of red and black rice flour.

One (1) kilogram of pigmented rice grains was cleaned thoroughly with clean water. Filths present from the grains were removed. Washed grains were placed in perforated trays then air dried for 20-30 minutes. Partially dried rice grains were transferred in stainless steel flat trays then placed in an oven drier where samples were dried at 75-80 ^{O}C for 4-6 hours. Dried samples were cooled to room temperature or about 30-35^{O}C for 10 minutes. Samples were placed in a multipurpose high-powered pulverizer then ground into flour. Pigmented rice flour was sifted through a sieve, packed in a clean metallic pouches, then stored in a cool, dry place until further use. Flour yields were from 850 grams to 950 grams of flour for every 1 kilogram of rice grains.

Experimental Design and Formulations of pawa added with pigmented rice flour.

This study aimed to develop a more enriched traditional rice delicacy "*pawa*", native to Piat, Cagayan, with increased nutritional value and good eating qualities using pigmented rice varieties (black rice and red rice). The ingredients and the amounts of base flour for *pawa* manufacture containing different substitution levels of pigmented rice flours to white glutinous rice flour (GRF) are summarized in table 1.

The five (5) different substitution levels using Black Rice Flour (BRF) in the base flour for the manufacture of *pawa* are listed as : (1) A (100% GRF; served as the control); (2) B (10% BRF & 90% GRFF); (3) C (20% BRF & 80% GRF); (4) D (30% BRF & 70% GRF); (5) E (40% BRF & 60% GRF); and (6) F (50% BRF & 50% GRF). The same five (5) different substitution levels using Red Rice Flour (RRF) in the base flour for the manufacture of *pawa* are listed as: (1) A (100% RRF; served as the control); (2) B (10% RRF & 90% GRFF); (3) C (20% RRF & 80% GRF); (4) D (30% RRF & 70% GRF); (5) E (40% RRF & 60% GRF); and (6) F (50% RRF & 50% GRF) (Table 1).

Table 1. Formulation of *pawa* containing different substitution levels of black rice flour and red rice.

Treatment	Glutinous rice flour (grf	Black rice flour (brf)	Peanut	Sugar	Salt	Water	Oil
Black Rice *Pawa*							
A(control)	1000	0	290	265	1.5	650	165
B(10%)	900	100					
C(20%)	800	200					
D(30%)	700	300					
E(40%)	600	400					
F(50%)	500	500					
Red rice *pawa*							
A(control)	1000	0	290	265	1.5	650	165
B(10%)	900	100					
C(20%)	800	200					
D(30%)	700	300					
E(40%)	600	400					
F(50%)	500	500					

Preparation of ready-to-eat (RTE) pawa added with pigmented rice flour

The procedure used in this study was adopted from the manufacturing process of Piat's *Pawa* Maker Association of Piat, Cagayan, but with some modifications.

Sweetened ground peanut preparation

Three hundred (300) grams of peanuts were roasted for 15 minutes until brittle using a frying pan. Skins of the roasted peanuts were removed by hands. Skinned roasted peanuts were coarsely ground using an electrical grinder. Ground peanuts were placed in a sauce pan then 265g of brown sugar was added, mixed and cooked for 10 minutes until the sugar melted and caramelized resulting into a uniform mixture. The cooked mixture was transferred in a clean plastic container then stored in a refrigerator until use.

Rice dough preparation

The dough for *pawa* was prepared following the different substitutions of the base flour using blackand red rice flours separately. In a large, clean stainless steel mixing bowl, flour, salt, oil and water were put together. All ingredients were then mixed using a mixer for 2 to 3 minutes until the desired dough consistency of slightly sticky but firm was achieved.

Ready-to-eat (rte) pawa preparation

Uncooked *pawa* samples were prepared by stuffing 5 grams of sweetened ground peanut in 15 grams of dough, then shaping it into buns. Each of the bun was lined in an initially cut clean banana leaf sheet with a size of 3 inches diameter. Uncooked buns lined with banana leaves were placed in a steamer then cooked for 20 minutes. Cooked *pawa* samples were cooled, packed in a clean nylon polyethylene bags, then vacuum sealed.

Sensory evaluation and statistical analysis

Pawa samples utilized with black rice flour and red rice flour were subjected to sensory evaluation, specifically 7-point hedonic scale quality scoring conducted by 25 semi-trained and untrained panelists consisting of faculty and staff from the Cagayan State University. Sample score sheet used can be seen in appendix C. The sensory attributes evaluated were color, aroma, flavour, texture, and general acceptability of *pawa* samples using the hedonic scale with "1" equalling to "not acceptable" and "7" equalling to "highly acceptable". Samples were presented with 3-digit code number. Water was provided for rinsing between samples. The panel was oriented or briefed regarding the use of the sensory score sheet specific for the product prior to evaluation. Fig. 1(a) shows the sample presentation of the coded *pawa* samples for sensory evaluation.

The data obtained from sensory evaluation were subjected to Analysis of Variance (ANOVA) at 5% level of significance, to determine whether or not there is a significant difference between the treatments. Duncan's New Multiple Range Test (DNMRT) was also employed to determine which treatments are significantly different from each other. The most preferred formulations were determined from both black and red *pawa* samples.

Proximate composition analysis

Rice flours and *pawa* samples utilized with glutinous white rice (control), black rice, and red rice were analyzed for the following chemical composition moisture content (%), protein content (%), fat content (%), ash content(%), crude fiber (%) carbohydrate content (%), following the method described by A.O.A.C (1990). Carbohydrate content was determined by computation. Carbohydrate (%) = 100% - (% moisture + fat + protein +ash).

Results and discussions

Sensory evaluation of "black" pawa samples.

Color

The importance of evaluating the color by sensory method is to obtain information the color acceptability or desirability of the food in human terms (McWilliams, 2001). Regardless of the food product's other excellent quality attributes, the consumer is less likely to buy the product if the quality of the color is not attractive and/or acceptable (Ahsan Ansari *et al.*, 2011). The mean scores of the different preparations of *pawa* incorporated with black rice flour was shown in table 2. The final color of the samples was associated with phenolic compounds present in pigmented rice pericarp used (Shakri *et al.*, 2021). Addition of black rice flour (BRF) in the preparation of *pawa* had a significant effect on the color acceptability. The incorporation of black rice flour has affected the color of the product from white to dark.

Generally, higher scores were observed in product with higher substitution of black rice flour. *Pawa* substituted with 50% BRF (6.48) obtained the highest mean score followed by *pawa* with 40% BRF substitution (6.44).

Both samples are comparable, but are significantly different from other samples. In contrast, the *pawa* samples with no black rice flour substitution was evaluated to have the least color acceptability among the formulations with a mean score of 1.68, however it did not differ significantly with *pawa* substituted with 10% BRF (1.72), but both are significantly lesser than the others.

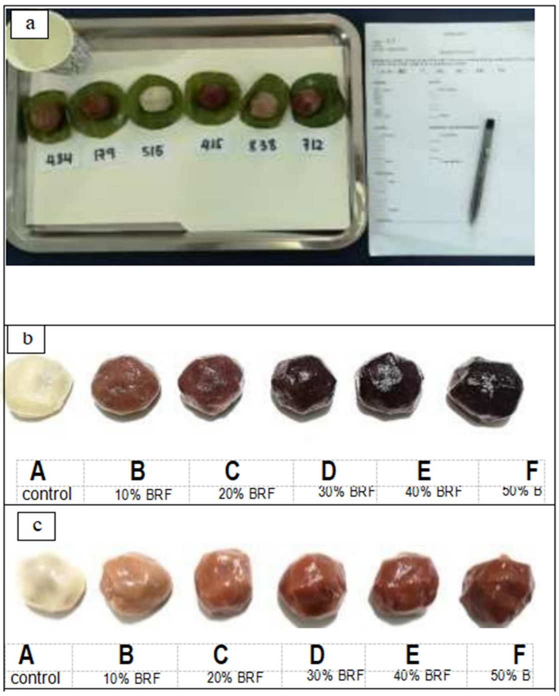

Fig. 1. Sample presentation of the (a) coded samples for Quality Scoring; (b) final appearances of *Pawa* using different substitution levels of black rice flour and (c) final appearnaces of *Pawa* using different substitution levels of red rice flour.

Aroma

In determining the overall acceptability of a food product, aroma is considered important particularly if the food is served hot or warm (Villarin *et al.*, 2021). Table 2 shows the acceptability of the aroma of *pawa* added with black rice flour. Results revealed that the scores for aroma among all sample varied significantly. Plain *pawa* obtained the least mean score with 1.96 acceptability rating. *Pawa* samples with 50% BRF and 40% BRF were significantly better in comparison with the other samples in terms of aroma. *Pawa* with 40% BRF was scored the highest with 6.16 rating followed by *pawa* with 50% BRF with mean of 6.12.

These observations was due to the aromatic characteristics of black rice imparted to the product resulting to a more desirable and acceptable aroma. Some pigmented or aromatic rice contains the main aroma compound 2-acetyl-1-pyrroline (2AP) that is responsible for the pandan-like distinct aroma (Beltran *et al.*, 2020).

Table 2. Mean scores of the sensory attributes of *pawa* used with different levels of black rice flour substitution.

Treatment	Sensory attribute				General
	Color	Aroma	Taste	Texture	Acceptability
A	1.68^{e}	1.96^{f}	1.92^{e}	6.00^{a}	4.40^{c}
B	1.72^{e}	2.36^{e}	6.04^{b}	5.96^{ab}	6.28^{ab}
C	3.56^{d}	4.20^{d}	6.60^{a}	3.68^{c}	6.48^{a}
D	5.24^{c}	5.00^{c}	3.92^{c}	3.52^{cd}	4.32^{c}
E	6.44^{ab}	6.16^{a}	3.76^{cd}	2.72^{e}	4.20^{c}
F	6.48^{a}	6.12^{ab}	1.76^{e}	2.68^{e}	4.00^{c}

* Means followed by the same letter on each attribute are not significantly different while means followed by different letter are significantly different with each other at 5% level of significance using DNMRT.

Taste

Table 2 shows the taste acceptability of "black" *pawa* and results showed that samples from all formulations significantly differ from each other. It was observed that *pawa* with 20% black rice flour substitution was most preferred by the panelists since pigmented rice in general provides richer taste (Kushwaha, 2016). However low scores were given by the panelists to *pawa* samples with 30%, 40%, and 50% black rice flour substitution. This might be because of the sweet taste of black rice resulting to a too much sweet product, aside from the other ingredients used such as sugar and peanut which contributed to the overall taste of the product particularly sweetness. Results also revealed that plain *pawa* did not differ significantly with *pawa* substituted with 50% black rice flour, both obtaining the lowest scores, 1.92 and 1.96, respectively, among other treatments.

Texture

The texture acceptability of *pawa* with different levels of black rice flour (BRF) substitution is shown in Table 2. Results revealed that *pawa* with no BRF substitution was evaluated to have the highest acceptability with 6.00 rating, but did not differ significantly with *pawa* with 10% BRF with a acceptability score of 5.96. It can be seen from the table that low rating scales were given by the panelists to samples with high amounts of black rice. Based on the result, it was observed that increased level of substitution of BRF negatively affected the textural properties of the *pawa*. This could be because the type of black rice used was non-glutinous. Glutinous rice flour was used for the control treatment which gave the *pawa* samples soft and sticky quality. Glutinous rice is differentiated from other rice varieties by having no or negligible amount of amylose and high amounts of amylopectin which are component of starch. The amylopectin is important in giving glutinous rice's sticky quality (Shakri *et al*., 2021).Texture is a critical attribute for food products. The food qualities textures have a relationship to product appearance and to its mouth evaluation as well (Villarin *et al*., 2021).

General Acceptability

The overall acceptability of the product is general assessment of the perception of the consumers (Villarin *et al*., 2021). Table 2 shows the overall acceptability of "black" *pawa*. Results showed that *pawa* with 20% BRF was evaluated the highest and the most preferred by the panelists with 6.48 mean rating followed by *pawa* with 10% BRF with 6.28 mean rating and both were significantly better from the other treatments. *Pawa* with the highest level of black rice flour substitution with a score of 4.00 was the least preferred by the panelist, but showed no significant difference from the control (4.40), *pawa* with 30% BRF(4.32), and *pawa* with 40% BRF (4.20).

Sensory evaluation of "red" pawa samples

Color

The food color is a very important quality attribute that is evaluated even before as food is tasted (Choi *et al*., 2022). Color measurements of food products is used by food processors as an indirect measurement of other quality attributes, such as antioxidants, and color correlate advantageously with other physic-chemical properties (Klunklin and Savage, 2018). Shown in table 3 are the mean scores of the different preparations of *pawa* incorporated with red rice flour (RRF). Results revealed that substitution of RRF in the preparation of *pawa* had a significant effect on the color acceptability where *pawa* with 40%RRF obtained a mean 6.36 and was evaluated the highest followed by *pawa* with 50% RRF with a score of 6.24. Among other samples, *pawa* samples from 40%RRF and 50%RRF were significantly better. In contrast, plain *pawa*, which served as the control, wasgiven the least score with 1.72 acceptability rating followed by *pawa* with 10% RRF with score 1.76, and both showed no significant difference from each other.

Aroma

Table 3 shows the acceptability of "red" *pawa* samples in terms of aroma. Based on the table, similar trend was observed with the results from utilizing black rice flour into *pawa*. Samples containing high amounts of red rice flour gave high desirability which were most preferred by the panelists. *Pawa* with 40%RRF and 50%RRF were evaluated the highest with the scores 6.12 and 6.08, respectively. Both did notdiffer significantly from each other, but were significantly better among other treatments. The presence ofthe aromatic compounds from red rice incorporated to *pawa* resulted to higher preference by the panelists.

Taste

Taste acceptability of "red" *pawa* samples is shown in table 4. *Pawa* samples with 30% red rice flour (RRF) was evaluated the highest with 6.04 rating, while *pawa* with 10% RRF was evaluated the least with a score of 1.60. *Pawa* with 30% RRF did not differ significantly with *pawa* with 20% RRF, as well as for between *pawa* with 10%RRF and the control.

Texture

The texture acceptability of *pawa* with different levels of red rice flour substitution is shown in table 3. *Pawa* with no red rice flour was evaluated the highest with a rating of 6.04, but it did not significantly differ with *pawa* used with 10% red rice flour, with a rating 5.92. Glutinous rice flour was used for the control which gave the *pawa* samples soft and sticky quality.

Glutinous rice is differentiated from other rice varieties since it has no or negligible amount of amylose and high amounts of amylopectin which are starch component. The amylopectin is important in giving sticky quality of glutinous rice (Shakri *et al.*, 2021).

Table 3. Mean scores of the sensory attributes of *pawa* used with different levels of red rice flour substitution.

Treatment	Sensory attribute				General
	Color	Aroma	Taste	Texture	Acceptability
A	1.72^{e}	1.92^{e}	1.88^{e}	6.04^{a}	4.16^{c}
B	1.76^{e}	2.28^{e}	1.60^{e}	5.92^{ab}	4.56^{c}
C	3.84^{d}	4.16^{cd}	5.88^{ab}	3.80^{c}	6.32^{ab}
D	5.20^{c}	4.56^{c}	6.04^{a}	3.32^{cd}	6.52^{a}
E	6.36^{a}	6.12^{a}	3.80^{d}	2.80^{e}	4.32^{c}
F	6.24^{ab}	6.08^{ab}	4.24^{c}	2.68^{e}	4.20^{c}

* Means followed by the same letter on each attribute are not significantly different while means followed by different letter are significantly different with each other at 5% level of significance using DNMRT.

General Acceptability

Shown in table 3 is the overall acceptability of *pawa* samples prepared with different levels of redrice flour substitution. Results revealed that *pawa* samples with 20% red rice flour and 30% red rice flour were not significantly different from each other and were the most preferred by the panelists over the other treatments. The general acceptability scores for the two formulations were 6.52 and 6.32, respectively.

Proximate composition analyses

Proximate composition analysis of rice flours

The quantitative study of macromolecules is known as proximate analysis refers to the quantitative study of macromolecules (Shakri *et al.*, 2021). Generally, these values are referred to as nutritional facts, which are usually seen on the label of food products (Shen *et al.*, 2009). The proximate analysis of rice flour used in the study was summarized in Table 4. Based on the result, white glutinous rice flour has the carbohydrate content. This corroborates with the findings of Shakri *et al.* (2021) that in general carbohydrate content in white rice exceeds 80%. Moisture content of the rice flours used ranged from 11.70 to 12.40. This range falls between the findings of Shakri *et al.* (2021) where moisture content in the rice varied between 10.04 – 12.88% (Shakri *et al.*, 2021). Moistrue content is the second highest component in rice and it plays an important role in controlling the shelf-life of the rice (Huang *et al.*, 2016). Results on ash content of the three rice flours demonstrated that black rice flour had the highest content with 1.83 g/100g followed by red rice flour with 1.62 g/100g. The most common minerals found in rice are magnesium, zinc, iron and calcium, (Rao *et al.*, 2014). According to Rathna *et al.*(2019), the zinc and iron content of red rice is two to three times higher than that of white rice. Ash content is highest in black rice and lowest in white rice (Shakri *et al.*, 2021). The amount of ash present in food samples plays an important role in determining the levels of essential minerals (Thomas *et al.*, 2013).

The fat content of the three rice flour flours were analyzed. The presence of fat in rice is a good source of linoleic acid and other essential fatty acids (Rathna *et al.*, 2019). The obtained fat content ranged from 0.50% to 2.27%. According to Blase (2020), the rice flour fat contents range from 0.22-2.10%. Several authors claimed that rice flour fat content of different rice varieties varies and thus values are variable may be due to varietal differences, environmental factors, processing of sample, and methods of milling (Han *et al.*, 2011).

Protein content of the flour from the three different varieties ranged from 5.93 to 7.58 (g/100g). Protein content from the black rice flour was the highest followed by the red rice flour. The results were in agreement with Thomas *et al* (2013) where the highest protein content was found in black rice. The nutritional quality and the eating quality of rice is influence by protein contents. (Rathna *et al.*, 2019). In addition, rice has a well- balanced amino acid profile due to the presence of lysine, in superior to other cereal grains. The pigmented rice has high protein content than polished white rice due to the presence of bran (Rathna *et al.*, 2019). Further, black rice is known as a fiber good source (Shakri *et al.*, 2021). The presence of fibre in the diet increases the bulk of faeces, which has a laxative effect in the gut (Rathna *et al.*, 2019).

Table 4. Proximate composition of glutinous white rice flour, black rice flourand red rice flour and plain *pawa*, *pawa* with 20% black rice flour,and *pawa* with 30% red rice flour.

Material	Composition (g/100g)					
A. Proximate composition of glutinous white rice flour, black rice flourand red rice flour						
Rice flour	Moisture	Ash	Fat	Protein	Carbohydrate	Crude Fiber
White	12.40 ±0.00	0.21 ±0.01	0.50 ±0.01	5.93 ±0.10	81.00 ±0.10	0.68
Black	11.93 ±0.06	1.83 ±0.01	2.72 ±0.01	7.58 ±0.17	75.93 ±0.19	1.82
Red	11.70 ±0.00	1.62 ±0.01	2.07 ±0.06	7.31 ±0.01	77.30 ±0.10	2.08
B. Proximate composition of plain *Pawa* with 20% black rice flour,and *pawa* with 30% red rice flour						
Pawa	Moisture	Ash	Fat	Protein	Carbohydrate	Crude Fiber
White	35.93 ±1.70	0.37 ±0.01	3.81 ±0.08	3.97 ±0.02	57.36 ±0.68	0.39
Black	31.63 ±0.75	0.56 ±0.01	4.69 ±0.19	4.44 ±0.03	58.67 ±0.55	0.55
Red	31.60 ±0.35	0.64 ±0.02	3.28 ±0.13	4.50 ±0.03	59.97 ±0.23	0.81

Proximate composition analysis of pawa samples

Plain *pawa*, which served as the control, *pawa* with 20% black rice flour, and *pawa* with 30% red rice flour were subjected to proximate composition analysis. *Pawa* with 20% black rice flour, and *pawa* with 30% red rice flour were selected based of their high acceptability in terms of all the sensory attributes from the sensory evaluation. Table 4 shows the chemical compositions of *pawa* samples utilized with different varieties of rice. The compositions of the product were contributed from the ingredients rice flour, peanut, sugar, water, and oil. Results revealed that moisture content was highest in *pawa* where 100% of white glutinous flour was used giving a content of 35.93g/100g, while samples with black and red rice flours gave moisture contents of 31.63g/100g and 31.60g/100g which were almost the same. The ash content was highest in samples with 30% red rice flour with 0.64 g/100g, followed by *pawa* substituted with 20% black rice flour with 0.56g/100g. Ash content for plain *pawa* was the least among the three giving a content of 0.37g/100g. The fat content of the three samples ranged from 3.28g/100g to 4.69g/100g.

Protein content was highest for the *pawa* with 30% red rice flour with content 4.50 g/100g followed by *pawa* with 20% black rice flour with content of 4.44 g/100g. Lowest protein content was obtained by the control which is the *pawa* used with no substitution of pigmented rice flour. For the carbohydrate content of the *pawa* samples, it can was observed that the obtained values were close to one another. Carbohydrate content of the three samples ranged from 57.36g/100g to 59.97g/100g.

Based on the results, *pawa* incorporated with black and red rice flours contained higher amount of nutrition compared to *pawa* used with white glutinous rice flour only. Pigmented rice varieties are rich in both anthocyanins and tocopherols which are also known as vitamin E. In addition, reduction of cancer, cardiovascular diseases, and liver damage are associated with the presence of anthocyanin (Chen *et al.*, 2016). Pigmented rice is a great source of potassium, iron, vitamin B and it is relatively high in protein. Moreover, several pigmented rice applications were studied. Pigmented rice powder extracted from the rice bran could be used as a healthful natural food coloring dyes in functional foods, sodas, neutraceutical and other health products (Veni, 2019). Black and red rice bran can be an excellent ingredient to increase the nutritional value and antioxidant properties of noodles (Murali *et al.*, 2020). Further, black and red rice and their value added products are becoming increasingly popular and they are widely consumed in Japan, Thailand, China, Korea, and other East Asian countries (Kushawa, 2016).

Conclusions and recommendations

Based on the results, *pawa* samples prepared with 10 to 20% black rice flour substitution and *pawa*samples with 20 to 30% red rice flour substitution were highly accepted by the panelists in terms of the products' overall acceptability. However, importantly, key attributes such as texture along with taste should be taken into consideration if a higher degree of acceptability is aimed for *pawa*. Substitution of up both black rice flour and red rice flour in the preparation of *pawa* also provided higher nutrition. The preparation of *pawa* utilized with black and red rice flour in this study had been acceptable and nutritive, however the process should still be improved to increase its consumer acceptability.

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