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Effect of Banana Peel Flour Substitution on Physical characteristic of Yellow noodles

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ABSTRACT

The most widely consumed fruit in Malaysia is the beloved banana. It is also a fruit that comes with a rather significant peel, and millions of those banana peels end up in the trash. They could be eaten instead. Some people in other parts of the world have been eating banana peels all along. They are fibrous and a bit bitter, aside from sidestepping some of that prodigious waste, banana peels also have nutritional appeal. They have a good source of resistant starch, non-starch polysaccharides including dietary fibre, antioxidants, polyphenols, essential minerals such as potassium, which are important for human health. In this research, it is aimed to develop nutritious yellow noodle formulations by substituting banana peel flour (BPF) with wheat flour (10%, 20% and 30%) and a control formulation with wheat flour was also prepared. The substitution BPF yellow noodles will affect the physicochemical properties and were assessed pH, colour, tensile strength and elasticity. As a result, banana peel noodles had lower L* darker colour and b* values (less yellow) than control noodle which could contribute by enzymatic browning in banana peel. But higher tensile strength and breaking length than control noodles. Physical analysis of yellow noodles showed that 10% BPF substitution noodles were not different from control noodles statistically ($p>0.05$). However, substitution levels of 20% and 30%, resulted in poorer physical properties. Sensory analysis indicated that all BPF substitution levels were acceptable, as determined by hedonic scala tests. By developing a nutritious banana peel yellow noodle alternative, it is expected to provide an alternative in the dietary diversity of individuals with health disease.

KEYWORDS

Yellow noodle, Banana peel, Banana peel powder.

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INTRODUCTION

Banana (Musa spp.) is tropical fruit that belong to the Musaceae family (Chakraborty et al., 2017). 'Saba' is the name given in the Philippines to a cooking banana belonging to the Saba subgroup. Its classification at the genome group level has been disputed ever since it was suggested to be a triploid derived from crosses between Musa balbisiana only (Valmayor, 2000). *Saba* banana is also familiar with name as *Pisang Nipah* and *Pisang Abu* in Malaysia*, Pisang Kepok in* Indonesia and *Kluai Hin* in Thailand. This Saba variety has distinctive sharp edges on its fruits about 3 to 5 edges. It has green colour when unripe and turn to yellow when ripe. Each cluster also can weight about 15 to 28 kg (Department of Agriculture Sabah, 2016). Saba bananas pulps are popular to be used as banana fritters and banana chips industry and less consumed as fresh. Green matured peel colour is more favoured for banana chips industry whereas the peel with yellow colour and firm pulp is used as banana peel fritters.

Banana is one of the most common crops grown in almost all tropical countries. The banana is an edible fruit, botanically a berry, produced by several kinds of large herbaceous flowering plants in the genus *Musa*. Bananas are cultivated widely by smallholders in many parts of Malaysia. Banana has a good nutritional value; therefore, it may be possible to produce several functional foods from it such as dried banana, snacks and others. As a result, 200 tonnes of waste from banana peels were generated each day and its trend is increasing (FAMA, 2007).

The peels are the main by-product of the banana processing industry, accounting 30% of the fruit which constitute environmental hazard. Banana peels represents 40% of the total weight of fresh banana (Ramli et al. 2009). At present, these peels are not being used for any other purposes and are mostly dumped as solid waste at large expense. It is thus significant and even essential to find applications for these peels as they can contribute to real environmental problems (Chakraborty et al, 2017).

Potential applications of banana peel depend on its chemical composition as well as physicochemical and functional properties. Like its pulp flour, peel can also be used for developing number of high value-added products. In previous study, Ramli et al. have development yellow noodles by partial substitution of wheat flour with green banana peel flour and the study reported that partial substitution of banana peel into noodles may be useful for controlling starch hydrolysis of yellow noodles.

Yellow noodles are widely consumed throughout the world and it is a fast growing sector of the noodle industry (Yousif et al. 2012). At least 12% of global wheat production has been estimated to be used for processing noodle products (Fao, 2005). Basic yellow noodles are made by adding kansui solution to the wheat flour and other ingredients. As to improve the nutritional value and functional properties of noodle products, many substitution flours were used including banana peel flour. It is believed to have a noodle with a good source of dietary fiber, antioxidants, polyphenols and essential minerals which are important for human health. Therefore, the objective of this project was to study the physicochemical properties of yellow noodle prepared by partial substitution of wheat flour with banana peel flour. The chemical composition of nutritional and anti-nutritional value was also studied.

MATERIALS AND METHODS

Materials

Basic ingredients for noodle preparation (wheat flour and kansui reagent) were obtained from a local supermarket.

Preparation of banana peel flour

Green bananas (stage 2 of ripening) were purchased from a local supermarket. The fruit was washed and separated into pulp and peel. To reduce enzymic browning, peels was then dipped in 0.5% (w/v) citric acid solution for 10 min, drained and dried in an oven (Memmert Oven, at 60°C overnight). The dried peels were ground in a Retsch Mill Laboratory to pass through 125μm sieve to obtain banana peel flour. Banana peel flour was stored in airtight plastic packs in cold storage (15±2°C) for further analyses.

Proximate analysis

Moisture content was determined with A&D MX50 moisture analyser. Crude protein (AOAC 988.05)., fat (AOAC 963.15), and fibre (AOAC 978.10). The carbohydrate content was determined by difference mean. Meanwhile the ash was identified by inserting the sample of 5 g into muffle furnace at 550 C until grayish colour obtain.

Mineral composition

Potassium, manganese and sodium were determine according to AOAC 968.08 (AOAC 2006). The sample were analysed in triplicate.

Anti-nutrient

Cyanide content was determined by alkaline picrate method. 5g of sample was allowed to dissolve in 50 ml distilled water overnight in a conical flask. Then 4 ml of alkaline picrate is mixed with 1 ml of sample filtered and let incubated in a water bath for 5 minutes. Then the absorbance was read at 490 nm after reddish brown colour is formed. The absorbance for blank sample with only mixture of 1 ml distilled water and 4 ml alkaline picrate also recorded. Different concentration of KCN solution in a 5001 conical flask containing 5-50 μg cyanide followed by addition of 1 N HCl also prepared to form cyanide standard curve. Then the cyanide content will be extrapolated from cyanide standard curve.

Meanwhile saponin by agitating mixture of 10g of sample with 100cm3 of 20% aqueous magnetic stirrer for twelve (12) hours at 55oC. The residues filtered by using Whatman No.1 filter paper and the residue was mix again with 200 cm3 of 20% aqueous ethanol. Then the mixture was reduced to about 40cm3 under vacuum using a rotary evaporator. After that the mixture was added with 20cm3 diethyl ether into a 250cm3 separatory funnel. Then it was shaken vigorously and aqueous layer form by the shaking process is removed. The colourless aqueous extract was obtained by continues purification process. The 4 g sodium chloride was added into aqueous solution to adjust the pH into about 4.5. Then the solution was shaken with butanol and washed with 10cm3 of 5% sodium chloride. The extract was then evaporated to dryness in a fume cupboard. The saponin was determine by weight and expressed in percentage.

Water holding and oil holding capacity

1 g of samples were weight into a centrifuge tubes. Then, 25 ml of distilled water or commercial palm oil cooking oil were added and simply stirred for uniform mixing. Then it the tubes were incubated at 40 ^{o}C for 1 hour. After that, tubes were centrifuge at 3000 rpm for 20 minutes by using centrifuge (Universal320). The supernatant was drained for about 10 minutes at 45^{0} and the residues were weight. The WHC and OHC calculated was in the form of weight of water and oil hold for 1g sample respectively.

Noodle preparation

Formulations for the noodles are shown in Table 1 and noodles were prepared using the method described by Sirichokworrakit et al. (2015). The basic noodle formula consisted of 100 g of wheat flour, 50 ml of distilled water, 1 g of salt and 1 g of kansui reagent. Three additional noodle samples were prepared by substituting wheat flour with 10 %, 20 % and 30% Banana peel flour. The different formulations were processed into noodles using a kitchen aid mixer. The prepared dough was placed to rest for a few minutes. The dough was passed through a small noodle machine for several times with the rollers gap reduce gradually, to get dough sheets. The final dough sheet was then cut with the noodle cutting roll with the dimensions of the resultant noodle strands were 2 mm in width and 1 mm in thickness. Noodles produced were coated with a thin layer of flour to avoid them from sticking together. All noodles were cooked by placing a small amount of noodles in a saucepan of boiling water (at a ratio of 1:10, one part noodles to 10 parts water) and were left to boil for 15 min. Cooked noodles were left to cool at room temperature for further analysis (Ramli et al. 2009).

Table 1: Formulation of noodle samples

Ingredients (g)	Type of noodles			
	Control	10% BPF	20% BPF	30% BPF
Wheat flour	100	90	80	70
Distilled water	50	50	50	50
Kansui reagent	1	1	1	1
Salt	1	1	1	1
Banana peel flour	0	10	20	30

Noodle pH analysis

The pH was measured using Mettler-Toledo Delta 320 pH meter calibrated with buffer solution of pH 4.0 and 10.0 respectively.

Noodle colour analysis

Colour analysis of noodles was carried out using UltraScan PRO Spectrophotometer (HunterLab) equipped with D65 illuminant using the CIE 1976 L*, a* and b* colour scale as described by Kruger et al. (1998). L* value is a measurement of brightness (0-100); a* value represents the red – green coordinates (- is green while + is red); b* value indicates the blue – yellow coordinates (- is blue while + is yellow). All measurements were performed in triplicate at random locations on the surface for each sample.

Noodle texture analysis

Texture properties of noodles were measured using texture analyser with optimal test conditions. Measurements were carried out 10 min after cooking the noodles during room temperature (Lu et al., 2009). Instrument settings were pulled to break mode: test speed 1 mm/s. Two texture parameters were obtained: tensile strength (maximum force; N) and breaking length (distance at maximum force; mm). Three replicates of noodles at each substitution of banana peel flour were determined.

RESULTS AND DISCUSSIONS

In this study, banana peel flour was produced dull in colour with visible dark spot. The moisture content for stage 2 of ripeness has higher values compared to the stage 5 of ripeness. This is because as the banana mature through time, the water may loss due to respiration. The stage 5 undergoes longer respiration process compared to stage 2 as it has to stored longer to achieve the stage 5 of ripeness. The water holding capacity for the banana peel is 4.00 g of water while for oil holding capacity is 0.91g of oil. It seems that the banana peel powder can retain water higher than the oil. The retention of banana peel powder to oil are correlated with the composition of protein with water and reaction of protein with other substances. Meanwhile the water retention of water also correlated with the composition of total starch to retain bound water.

Banana peel noodles that produced within this study also is determined differently with the commercial yellow noodles in industry. The dimension of banana peel noodle was formed to be circular flat to ease textural evaluation with thickness ranged from 1.9 to 3.0 mm and length longer than 15 cm. Control noodles produced were rather creamy with yellowish colour than darker colour in substitutions noodles as the different can be seen in Figure 1 with Figure 2, 3 and 4 respectively. Noodles were cooked as the same way by a normal consumer in the home. The pH of noodle increases as the substitution of banana peel flour increase but it dropped slightly after cooking process. These changes may reflect leaching and loss of salts into the boiling water.

Figure 1: Control noodle

Figure 2: 10% BPF noodle

Figure 3: 20% BPF noodle

Figure 4: 30% BPF noodle

Colour is one of the most important factors in determining consumer acceptance. Colour characteristics of noodles are shown in Table 2. Based on the obtained result, it indicates that the colour of control noodle had higher L* and b* value than noodles with substitution of banana peel flour. The noodles with banana peel flour appeared duller in colour compared to the control noodle. Dull in colour might be caused by certain enzyme which present in banana peels that contribute to the enzymatic browning and also during drying process of banana peels. This is an acceptable reason since the enzymatic browning of banana is a well-known problem (Ramli et al. 2009).

Table 2: Colour characteristics of noodles

Sample	L*	a*	b*
Control noodle	68.50 ± 0.45	1.55 ± 0.27	22.55 ± 0.75
10% BPF noodle	46.82 ± 2.40	2.89 ± 0.70	9.96 ± 0.82
20% BPF noodle	40.35 ± 0.46	2.37 ± 0.20	7.53 ± 0.33
30% BPF noodle	37.33 ± 0.66	1.75 ± 0.26	5.89 ± 1.06

The texture characteristics of control noodle and with substitution of banana peel flour are compared in Table 3. The parameters of noodle texture are focused on its tensile strength and breaking length at maximum force. It has shown that the tensile strength and breaking length of the noodles were significantly different with the increasing of banana peel flour substitution. Increase of banana peel flour substitution caused the tensile strength increased, while breaking length decreased. The properties might be due to the lower composition of protein in banana peel flour than wheat flour. Low content of protein will decrease the thermostability of the gluten formation, which then contribute to the strength and firmness of noodle texture (Kovacs et al. 2004).

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Table 3: Texture characteristics of noodles

Sample	Tensile strength (N)	Breaking length (mm)
Control noodle	0.18	14.58
10% BPF noodle	0.17	12.73
20% BPF noodle	0.16	11.86
30% BPF noodle	0.13	10.94

CONCLUSIONS

Based on the study, it is possible to produce noodles with addition of banana peel flour with wheat flour up to at least 10% substitution. In general, the substitution of banana peel flour will result in duller noodles but still acceptable colour at a 10% blend. The pH of noodle from banana peel flour is slightly higher than control noodle. The results show that noodles made from banana peel flour had darker colour compared to control noodle which appeared bright yellowish colour. For textural properties, the noodles made from banana peel flour had weaker structure than the noodles made from wheat flour. Lastly, the substitution of banana peel flour into noodles is accepted as banana peel itself had a good source of resistant starch, non-starch polysaccharides including dietary fibre, antioxidants, polyphenols, essential minerals and various vitamins which are important for human health.

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