IPS Journal of Nutrition and Food Science
IPS J Nutr Food Sci, 2(2): 46-51 (2023)
DOI: https://doi.org/10.54117/ijnfs.v2i2.24

Antioxidant and Dietary Fibre Content of Noodles Produced From Wheat and Banana Peel Flour

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Abstract

This study aimed to utilize flour from banana peel to develop functional noodles. Banana peel flour was substituted in wheat flour at 11, 13 and 15 %, was used to produce noodles. Composite noodles produced were evaluated for cooking characteristics, dietary fibre content, glycemic index, colour attribute and sensory evaluation. Result of cooking characteristics of the noodles indicated that the noodles containing banana peel flour had higher water uptake (10.25 – 11.25%) and cooking loss (6.28 – 7.59%) contents but an interestingly lower optimum cooking time (4.19 – 3.65 min) than their counterparts containing only wheat flour. The IDF value of the noodles varied from 8.26 - 12.18%. The highest value was observed in sample 13% and 15% banana peel flour supplemented with wheat flour while the lowest value was recorded in sample 100 % wheat flour. Increase in addition of banana peel flour led to an increase in antioxidant properties and dietary fibre content of the noodles. The glycemic index of the noodles varied from 58.74 - 65.28%. The highest value was observed in sample 100% wheat flour while the lowest value was recorded in sample 15% banana peel flour supplementation. It was concluded that the use of flours from banana peels as composites of wheat had good potential for production of nutritionally and functionally superior noodles compared to the use of wheat alone. This study may be an economically viable approach towards promoting utilization of food wastes for production of value added products in developing countries.

Keywords: *Noodles, Composite Flour, Banana Peels, Heavy Metals, Anti-nutrients*

Article History
Received: 14 Mar 2023
Accepted: 26 Jul 2023
Published: 16 Aug 2023

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How to cite this paper: Oguntoyinbo, O. O., Olumurewa, J. A. V., & Omoba, O. S. (2023). Antioxidant and Dietary Fibre Content of Noodles Produced From Wheat and Banana Peel Flour. *IPS Journal of Nutrition and Food Science*, *2*(2), 46–51. https://doi.org/10.54117/ijnfs.v2i2.24.

1. Introduction

With the constant increase in the consumption of bread and other baked products such as cookies in many developing countries, coupled with ever-growing urban populations, the composite flour technology in the making of baked food products could be very useful (Olaoye and Ade-Omowaye, 2011). Consumers' awareness on the need to eat healthy and functional foods is increasing worldwide and health conscious consumers prefer food that furnish extra health benefits beyond the basic nutritional requirements (Baba *et al.*, 2015). Therefore, there is a trend to produce functional foods such as noodles made from wheat flour and health promoting compounds from non-wheat flours known as functional ingredients (Dewettinck *et al.*, 2008).

Banana (*Musa spp*.) is among the leading fruit crops in the economic value in the world. It is ranked the fifth in the world trade (Iman and Akter, 2011). Banana peels have various health benefits to excellent nutritional status, and it treats the intestinal lesion, diarrhoea, dysentery, ulcerative colitis, nephritis, gout, cardiac disease, hypertension, and diabetes (Iman and Akter, 2011). Banana peels are rich in phenolic compounds as they are a good source of antioxidants, which protect against heart disease and cancer (Someya *et al.*, 2002). Banana peel wastes from industrial processes represent about 40% of fresh bananas (Anhwange *et al.*, 2009). These wastes pose an environmental problem for their generation of large quantities of organic waste. Researchers have shown that noodles flour from banana peels lowers glycemic index and reduces the duration of digestion due to the high content of resistant starch (Li *et al.*, 2006).

Recently, the food industry is dealing with high rate of food waste which is produced by fruit processing of different products such as juices, wines, jams, purees, etc. (Mahloko *et al.*, 2019). Re use of banana processing waste, such as peel, could improve the yield of raw materials and subsequently minimise the large waste disposal problems faced by the food industry (Mahloko *et al.*, 2019). Therefore, the economic and technological feasible alternative will be to produce flours from banana peels to make new products such as noodles or to partially incorporate these flours in wheat flour in order to improve the nutritive value of confectionaries such as noodles. The peel, main by-product of the banana processing industry represents approximately 30% of the fruit. This by-product

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constitutes an environmental problem because it contains large quantities of nitrogen and phosphorus and its high water content makes it susceptible to modification by microorganisms (Arun *et al.*, 2015). The banana fruits are consumed at different stages of maturity and the amount of peels is expected to increase with the development of processing industries that utilise the green and ripe banana. Banana peel flour potentially offer new products with standardised compositions for various industrial and domestic uses (Emaga *et al.,* 2007). Various studies have been conducted to investigate possible value addition to banana peel including the production and evaluation of banana peel flour (Ragace *et al.*, 2006), the effects of ripeness stage on the dietary fibre components and pectin of banana peels (Emaga *et al.,* 2007), production of biscuits from banana and prickly peel flours (Mahloko *et al.*, 2019. The present study therefore is aimed at evaluating antioxidant properties and dietary fibre contents of noodles produced from composite flours of wheat and banana peels.

Materials and Methods

Materials

Source of raw materials and flours preparation

Fresh matured banana (at stage 5 of ripening: yellow) was obtained from a market in Oja Oba, Akure, Ondo State, Nigeria. The samples were selected and separated into pulp and peel. To reduce enzymatic browning, the banana peels (stage 5 of ripening) were dipped in 0.5% (w/v) citric acid solution for 10 minutes. The peels were drained and dried in cabinet oven at 50°C until constant weight obtained. The dried peels were milled in a Retsch mill laboratory (Retsch AS200, Ham, Germany) to pass through 40 mesh screens of aperture of 0.25µm size to obtain banana peel flour. Flour was stored in airtight plastic packs in cold storage (15±2°C) for further studies. All reagents used were obtained from the Departmental Laboratory of Food Technology, Lagos State University Science Technology, Ikorodu,Lagos, Nigeria

Formulation and optimization of wheat – banana peel flours

The flour blends combination of wheat and banana peel flour in percentage were determined using Optimal Mixture Design of Response Surface Methodology (Design Expert 9.0). Thirteen formulations were generated by the software and were analysed for phenols, flavonoids and dietary fiber contents as the dependent variables. The desirability function approach (DFA) was used to simultaneously optimize the responses. Three optimum blends were selected for the wheat – banana peel noodles production and 100% wheat flour was used as control (Table 1).

Table 1: Optimum flour blends for production of wheat – banana peel based noodles.

Runs	Wheat flour	Banana peel flour
Control	100	-
4	89	11
8	87	13
10	85	15

Preparation of wheat – banana peel noodles

The four optimum blends were used in the preparation of *noodles*. Wheat flour, banana peel flour, chilli powder plus 2.5 g of guar gum, 5 g of salt, 0.5 g of sodium bicarbonate, 2 g of Sodium tripolyphosphate (STPP) and 200 mL of warm water was mixed and stirred until smooth. The dough was then allowed to stand for 10 minutes. The dough was then made into the sheets (sheeting) with a thickness of 1.6 mm and the cut. The cut noodle was steamed for 10 minutes at 100°C and then dried for 5 hours at 50°C. The dried noodles was finally packed in a zip lock bags for further analysis.

Methods

Determination of cooking characteristics of the noodles samples

The cooking quality of the cooked noodles were examined. The following parameters were determined: water uptake, optimum cooking time (min), Cooking gain (%) and cooking loss (%), according to the method of Ugarčić-Hardi *et al.* (2007). obtained by gravimetry..

Determination of dietary fibre content noodles samples

The dietary fibre analysis was carried out as described in “McCleary Method (AOAC, 201). The dietary fiber content in the sample was measured in the laboratory by an enzymatic-gravimetric method. The sample was defatted by weighing 2.0 g of the sample into the pre-cleaned 250 mL capacity borosilicate beaker and the sample was extracted with 30 mL of the petroleum spirit for three consecutive times with soxhlet extractor.

Determination of antioxidant properties of noodles

Total phenolic content

The total phenolic (TP) content in banana peel extracts were spectrophotometrically determined by Folin Ciocalteu reagent assay using garlic acid as standard (Ojure and Quadri, 2012). The absorbance was determined at 750 nm using spectrophotometer (Unicum UV 300). The total phenolic content in the samples was expressed as mg garlic acid equivalents (GAE/g) dry weight sample. All samples were analyzed in triplicates.

Total flavonoid content

Total flavonoid (TF) of banana peel extracts were spectrophotometrically determined by the aluminum chloride method using quercetin (Zhishen *et al.*, 1999). The absorbance was measured against blank at 510 nm by using spectrophotometer (Unicum UV 300). Total flavonoids in sample were expressed as mg quercetin equivalents (QE)/g dry weight. All samples were analyzed in triplicates.

Measurement of antioxidant activity by DPPH radical-scavenging assay

DPPH scavenging activity was measured using the spectrophotometric method with slight modifications (Brand-Williams *et a.*, 1995). The absorbance of DPPH diluted in methanol was considered as control. The decrease in absorbance was measured at 517 nm. The antioxidant capacity to scavenge the DPPH radical was calculated by the following equation:

$$\text{Scavenging effect (\%)} = \frac{(1 - \text{absorbance of sample})}{(\text{absorbance of control})} x100 \text{ (Omoba } et\ al., 2015)$$

FRAP (Ferric Reducing Antioxidant Power)
The reducing property of the extract was determined as described by Pulido *et al.* [23]. An aliquot of 0.25 mL of the extract was mixed with 0.25 mL of 200 mM of sodium phosphate buffer pH 6.6 and 0.25 mL of 1% Potassium Ferrocyanate (KFC). The mixture was incubated at 50°C for 20 min followed by the addition of 0.25 mL of 10% Tricarboxylic acid (TCA). The mixture was centrifuged at 2,000 ×g for 10 min and 1 mL of the supernatant was mixed with equal volume of distilled water and 0.1% of iron (III) chloride ($FeCl_3$) and the absorbance were measured at 700 nm using a JENWAY UV–visible spectrophotometer.

Sensory evaluation
The Sensory attributes of the enriched and control noodles samples were evaluated with 50 semi-trained panel ists who are members of the Department of Food Science and Technology with basic knowledge of food sensory assessment. Nine-point hedonic scale (1= dislike extremely to 9 = like extremely) was used to rank preferential scores. The panelists were served the *noodles* samples randomly and sensory assessments were done with respect to aroma, appearance, taste, texture, finger feel, after taste and overall acceptability.

Ethical Approval
The sensory experimental protocol was approved by the ethics committee at School of Agriculture and Agricultural technology, Federal University of Technology Akure, Ondo, Nigeria (FUTA/SAAT/2019/013) and conforms to the ethical principles set forth in the declaration of Federal Government of Nigeria.

Statistical Analysis
All analyses were carried out in triplicate and data generated were subjected to One-Way Analysis of Variance (ANOVA) using Statistical Package for Social Sciences (SPSS) version 20.0. The means were separated using Duncan's Multiple Range Test at 95% confidence level ($P < 0.05$).

Results and Discussion

Cooking characteristics of the wheat – banana peel noodles
Banana peel flour addition caused significant differences in water uptake, optimum cooking time, Cooking gain and cooking loss of noodle samples ($p<0.05$) as shown in Table 2. Banana peel flour addition positively affected the water uptake of noodles. The noodle samples with banana peel flour had significantly higher water uptake values (10.25 – 11.25%) as compared to those of the control sample (without banana peel flour) (9.61%) ($p<0.05$).

The optimum cooking time ranged from 3.65 – 4.35 min for the noodle samples with sample containing 15% banana peel flour and the control having minimum and maximum values, respectively as shown in Table 2. The values showed that as percentage of substitution of gluten-rich (wheat) flour with non-gluten (banana peel) flour, there is reduction in cooking time of the instant noodle. This may be attributed to discontinuity within the gluten matrix, which resulted in weak dough properties (Omeire *et al.,* 2015). There is significant difference ($p< 0.05$) in the noodles cooking time at all levels of substitution. The cooking time values of wheat – banana peel flour noodle compared favourably with 3.11 – 4.77 min for bread fruit-konjac-pumpkin-wheat instant noodle (Purwandari *et al.*, 2014); 4.5 – 8.29 min for plantain-wheat instant noodle (Ojure and Quadri, 2012) and 4.3 – 5.41 min for corn-tapioca-wheat instant noodles but lower than 5.6 – 6.6 min reported by Ritika *et al.* (2016) for malted and fermented cowpea-wheat instant noodle; 7.33 – 8.67 min for sago starch-wheat instant noodle (Sharoba *et al.,* 2013); 7.30 min for defatted rice bran-soy- wheat instant noodle (Suresh *et al.,* 2015) and 7.16 – 9.36 min reported for raw jackfruit-wheat instant noodle (Kumari and Divakar, 2017).

Table 2: Cooking characteristics of wheat – banana peel noodles

Sample	Water uptake (%)	Optimum Cooking time (min)	Cooking gain (%)	Cooking loss (%)
NA1	9.61±0.55d	4.35±0.01a	185.40±2.11a	5.47±0.01c
NB2	$10.25±0.81^c$	$4.19±0.01^b$	$173.75±1.78^b$	$6.28±0.01^b$
NC3	$10.90±1.09^b$	$4.01±0.02^b$	$173.70±1.83^b$	$7.24±0.02^a$
ND4	$11.25±0.95^a$	$3.65±0.01^c$	$169.91±1.56^c$	$7.59±0.02^a$

*Values are means of three replicates. Mean values ± standard deviation followed by different superscripts across columns are significantly different ($p≤0.05$). NA1 = 100% Wheat flour, NB2 = 89% Wheat flour + 11% Banana peel flour, NC3 = 87% Wheat flour + 13% Banana peel flour, ND4 = 85% Wheat flour + 15% Banana peel flour.

The cooking gain values ranged from 169.91 – 185.40% with the control having the highest value whilst noodles from 15% banana peel flour addition had the lowest value. There is significant difference ($p<0.05$) among the noodles' cooking gain. The results obtained compared favourably with 120.7 – 160.3% reported by Ritika et al. (2016) for malted-fermented cowpea-wheat instant noodle however lower than 252 – 379% and 287 – 362% reported by Purwani *et al.* (2014) for sago starch-wheat instant noodle and Foo *et al.* (2011) for soy protein isolate-wheat instant noodle respectively.

Cooking loss values ranged from 5.47 – 7.59 with the control having the lowest value whilst noodles from 15% banana peel flour addition had the highest value. The cooking loss results obtained compared favourably with 6.39 – 10.40% reported by Ojure and Quadri (21) for cassava-wheat instant noodle but higher than 0.93 – 1.63% and 2.01 – 6.19% reported by Ritika *et al.* (2016) for malted-fermented cowpea wheat instant noodle and Purwandara *et al.* (2014) for sago starch wheat instant noodle, respectively. Purwandari *et al.* (2014) reported that cooking loss of instant noodles from blends of breadfruit, konjac, pumpkin and wheat flours, ranged from 12.45 – 17.04%. These results are in the agreement with the study of Martinez *et al.* (2007) who reported that partial or complete substitution of durum wheat semolina with fibre material can result in negative changes to pasta quality, including increased cooking loss. The high cooking loss recorded by the banana peel supplemented noodles as substitution increases could be due to a weakening of the protein network by the presence of banana peel (non-gluten protein) flour which allows more solids to be leached out from the noodles into the cooking water (Wu *et al.*, 2006). Also, Izydorczyk *et al.* (2008) reported that cooking losses are attributed to the weakening and/or disruption of the protein-starch matrix. In this study, the increasing of cooking loss could be due to a disruption of the protein – starch matrix. This might be diluted gluten fraction by banana peel flour.

Dietary Fibre of Noodles Produced from Blends of Wheat and Banana Peel Flour

The dietary fibers of the noodles produced from blends of wheat and banana peel flour as shown in Table 3. The IDF value of the noodles ranged from 8.26 - 12.18%. The highest value was observed in sample 13 % and 15 % banana peel flour supplemented with wheat flour while the lowest value was recorded in sample 100 % wheat flour. There was no significant difference (p<0.05) among the samples except sample 100 % wheat flour. There was a significant increase in the total dietary fiber content of noodles incorporated with banana. The value of soluble dietary fibre ranged from 4.08 - 6.14%. The highest value was observed in sample 13% and 15% banana peel flour supplemented with wheat flour while the lowest value was recorded in sample 100% wheat flour.

Table 3: Dietary Fibre of Noodles Produced from Blends of Wheat and Banana Peel Flour

Sample	IDF (%)	SDF (%)	TDF (%)	IDF/SDF
NA1	8.26±0.14[d]	4.08±0.12[d]	12.34±0.13[d]	2.02
NB2	10.52±0.30[c]	5.21±0.11[c]	15.73±0.15[c]	2.01
NC3	12.18±0.22[b]	6.14±0.12[b]	18.32±0.26[b]	1.98
ND4	14.15±0.21[a]	7.16±0.06[a]	21.31±0.09[a]	1.97

*Values are means of three replicates. Mean values ± standard deviation followed by different superscripts across columns are significantly different at (p≤0.05). NA1 = 100% Wheat flour, NB2 = 89% Wheat flour: 11% Banana peel flour, NC3 = 87% Wheat flour: 13% Banana peel flour, ND4 = 85% Wheat flour: 15% Banana peel flour

There was no significant difference at (p<0.05) among the samples except sample 13% and 15% banana peel flour substitution. The Total dietary fibre value of the noodles varied from 12.34 - 21.31%. The highest value was observed in sample 15% banana peel flour supplementation while the lowest value was recorded in sample 100% wheat flour. There was significant difference (p<0.05) among the samples. The IDF/SDF value of the noodles was 1.94 - 2.02%. The highest value was observed in sample 100% wheat flour while the lowest value was recorded in sample 15% banana peel flour substitution. It was observed that Insoluble Dietary Fibre, Soluble Dietary Fibre and Total Dietary Fibre increased as the substitution level increased. During preparation of noodles, some of the components present in banana peel flour might have contributed to the increment. This has been eelier observed in the formation of resistant starch in wheat flour and soybean during baking, extrusion or cooking. Thus, an increase in the dietary fiber parameters may be due to the formation of resistant starch and formation of cross-linked polysaccharides/ protein, which are resistant to digestive enzymes.

Since noodles prepared by incorporation of banana peel flour had increased the total dietary fiber content, it may be an alternative food for people with special calorific requirements and can be included in the category of functional foods. Soluble fibres are well known to lower serum cholesterol and to help reduce the risk of colon cancer, whilst the consumption of insoluble fibre has been shown to be beneficial on intestinal regulation and stool volume (Saifullah *et al.*, 2009).

Glycemic index and Antioxidant properties of Noodles Produced from Blends of Wheat and Banana Peel Flour

The glycemic index and antioxidants of the noodles produced from blends of wheat and banana peel flour are shown in Table 4. The glycemic index of the noodles ranged from 58.74-65.28%. The highest value was observed in sample 100% wheat flour while the lowest value was recorded in sample 15% banana peel flour supplementation. There was significant difference (p<0.05) among the samples except sample 13% and 15% banana peel substitution. The carotenoid content of the noodles ranged from 0.08 - 0.22 mg/kg. The highest value was observed in sample 15% banana peel flour supplementation while the lowest value was observed in sample 100% wheat flour. There was significant difference (p<0.05) among the samples except sample 11% and 13% banana peel supplementation. The total phenolic content increased of the noodles ranged from 2.58 - 7.20 mgGAE/g. The highest value was observed in sample 15% banana supplementation while the lowest value was observed in sample 100% wheat flour. There was significant difference (p<0.05) among the samples except sample 11%and 13% banana peel flour substitution. It was observed that the total phenolic increased significantly as the substitution level of banana peel flour increased. The high Total phenolic values in banana peel flour samples are attributed to 87.41 mg/100 g of ascorbic acid concentration in fruit peels per dry weight as stated by Anwar and Sallam (2016).

Table 4: Glycemic index and Antioxidant properties of Noodles Produced from Blends of Wheat and Banana Peel Flour

Sample	Glycemic Index (%)	Carotenoid (mg/g)	Total phenolic (mgGAE/g)	Total flavonoid (mgQE/g)	FRAP (mgAAE/100g)	DPPH (IC_{50} mg/ml)
NA1	65.28±1.54[a]	0.08±0.00[c]	2.58±0.26[c]	3.01±0.17[c]	19.28±0.11[ab]	8.50±1.11[a]
NB2	62.96±2.40[ab]	0.14±0.01[b]	6.25±0.05[b]	3.33±0.12[ab]	17.37±1.66[b]	5.34±1.11[b]
NC3	59.54±3.86[b]	0.18±0.00[b]	6.04±0.13[b]	3.99±0.81[b]	18.96±1.03[ab]	4.80±1.05[b]
ND4	58.74±2.61[b]	0.22±0.01[a]	7.20±0.78[a]	5.82±0.17[a]	19.45±0.26[a]	5.26±1.05[b]

Control = 100% Wheat flour. *Values are means of three replicates. Mean values ± standard deviation followed by different superscripts across columns are significantly different (p≤0.05).

NA1 = 100% Wheat flour, NB2 = 89% Wheat flour + 11% Banana peel flour, NC3 = 87% Wheat flour + 13% Banana peel flour, ND4 = 85% Wheat flour + 15% Banana peel flour

According to Rebello *et al.* (2014), banana fruits contain phenolic compounds such as catecholamines, phenolic acids and flavonoids. For banana, the availability as well as the quantity of these health beneficial nutrients is influenced by various factors such as ripening stages of the fruit, location, climatic factor, agricultural and cultural practices. The findings in the present study show a similar trend to studies by Elhassaneen *et al.* (2016) where incorporation of prickly pear peel and potato peel powders at 5% level improved the Total phenolic content of the biscuits from 110.23 to 143.28 and 192.79 mgGAE/ g of sample. The total flavonoid content of the noodles ranged from 3.01 - 5.82 mgQE/g. The highest value was observed in sample 15% banana peel supplementation while the lowest value was observed in sample 100% wheat flour There was significant difference at ($p<0.05$) among the samples. The FRAP content of the noodles ranged from 17.37 - 19.45 mgAAE/g. The highest value was observed in sample 15% banana peel flour while the lowest value was observed in sample 11% banana peel flour supplementation. There was significant difference ($p<0.05$) among the samples except sample 100% wheat flour and 13% banana peel supplementation. The DPPH $_{IC50}$ content of the noodles varied from 4.80 - 8.50. The highest value was observed in sample NC_3 while the lowest value was observed in sample NA_1. There was no significant difference ($p<0.05$) among the samples except sample NA_1. The DPPH inhibition for plant materials normally follows a similar order of the TPC and TFC, for example, the DPPH increases when concentration of phenolic compounds or degree of hydroxylation of the phenolic compounds increases. This report is in agreement with this current research because it was observed that the DPPH increased as the level of banana peel flour increased. This result was contrary to the result obtained by Fatemeh *et al*. (2012) where the DPPH did not follow Total Phenolic Content and Total Flavonoid Content order on Banana Peel Flour. Baba *et al.* (2015) reported that processing steps such as baking and microwave roasting increase the antioxidant activity of baked products. This finding is consistent with a report by Jan *et al.* (2015) where buckwheat flour was incorporated into wheat flour at 20 and 40% and resulted in improved % DPPH of composite flour from 55.53 to 57.18 and 61.65%, respectively. FRAP values ranged from 1.41 to 1.51 mg/g in BPF and PPF, respectively and from 0.57 to 0.71 mg/g for control and composite flours. FRAP values showed significant difference ($p<0.05$) in all composite

Sensory evaluation of noodles produced from wheat-banana peel flour

The hedonic test on parameters such as color, texture and taste of cooked noodles supplemented with banana peel flour as presented in Table 5. Noodles (control) had a creamy white color, while noodles incorporated with 11% to 15% banana peel flour had a brownish creamy color. However, there was significant difference ($P\leq0.05$) between control and noodles incorporated with banana peel flour up to 15% level with reference to color, taste and texture. Noodles containing 15% scored less for taste, which was not acceptable to the panelist. From the sensory analyses, it was concluded that banana peel flour could be incorporated up to 11% level in the formulation of noodles.

Table 5: Sensory Evaluation Score of Wheat-Banana peel noodles

SAMPLE	Taste	Colour	Flavour	Texture	Overall acceptability
NA1	8.15 ± 0.77^a	7.25 ± 0.79^a	6.59 ± 0.09^a	7.23 ± 0.68^a	8.56 ± 0.71^a
NB2	6.73 ± 0.59^b	4.38 ± 0.49^b	6.18 ± 0.53^b	6.45 ± 0.64^b	6.59 ± 0.79^b
NC3	6.32 ± 0.67^c	4.16 ± 0.47^b	6.37 ± 0.69^{ab}	6.29 ± 0.87^b	5.47 ± 0.68^c
ND4	4.43 ± 0.57^d	3.15 ± 0.39^c	4.50 ± 0.48^c	4.62 ± 0.58^c	4.21 ± 0.57^d

*Values are means of three replicates. Mean values ± standard deviation followed by different superscripts across columns are significantly different ($p\leq0.05$). NA1 = 100% Wheat flour, NB2 = 89% Wheat flour + 11% Banana peel flour, NC3 = 87% Wheat flour + 13% Banana peel flour, ND4 = 85% Wheat flour + 15% Banana peel flour

Conclusion

Banana peel flour is a good source of phytochemicals such as polyphenols, carotenoids and dietary fibers. Incorporation of banana peel flour increased the polyphenol, carotenoid and dietary fiber contents of noodles and it also exhibited improved antioxidant activity. The studies on cooking quality and sensory evaluations showed that the noodles incorporated with banana peel flour up to 11% level resulted in products with good acceptability. Therefore, banana peel flour enriched noodles increased nutraceutical property the of the product by increasing its antioxidant activity. Development and utilization of such functional and nutritional products can be used to improve the nutritional status of the population, which can impart health benefits by preventing degenerative diseases.

Acknowledgements

The authors greatly appreciate the constructive contribution of Lagos State University of Science and Technology and Federal University of technology, Akure, Nigeria for giving us this opportunity to carry out the analyses in their laboratories and for other valuable assistance.

Conflicts of Interest

There are no conflict of interest.

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