Physicochemical, Textural and Sensory Characteristics of Instant Noodles Produced from Wheat and Plantain Flour Blends, Spiced with Ginger

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ABSTRACT

The work was aimed at evaluating the physicochemical, textural, cooking and sensory characteristics of instant noodles produced from wheat and plantain flour blends, spiced with ginger. The unripe plantain was dried to final moisture content of 11.28% (w/w) and finely ground into powder. Wheat, plantain and ginger flour were prepared and blended in the following ratios; 100:0:0, 90:10:4, 80:20:4, 70:30:4, 60:40:4, 50:50:4 and labelled WF, WPGF1, WPGF2, WPGF3, WPGF4, and WPGF5, respectively. Increasing levels of unripe plantain flour, caused significant decrease in the whiteness index of the noodles from 77.23 to 57.08. The protein content of the composite noodles decreased from 10.70% (control) to 10.05% for 10% noodle sample. The decrease in the carbohydrate contents of the noodles from 65.27% (Control) to 64.83% for 10% noodle sample was not significant. Percentage Ash, fiber and fat content of the noodles increased with increase substitution of plantain flour from 1.18 to 2.61, 0.40 to 1.13 and 16.01 to 19.75%, respectively. Cooking time decreased significantly from 4.40 to 3.2 8 while cooking loss and water absorption increased significantly from 5.92 to 10.01% and 9.82 to 13.15% respectively. Unripe plantain increase resulted in significant increase in noodle hardness but to a great extent did not affect noodle springiness, cohesiveness, gumminess, chewiness and resilience. There was no significant difference between the 7.20 and 7.67 values obtained from appearance of cooked noodles for control and 10% composite. Overall acceptability score of 7.80 and 7.60 between control and 10% composite noodles, physicochemical, wheat, textural, sensory, plantain, composite noodles were not significantly different.

Keywords: cooking, ginger, noodles, physicochemical, plantain, sensory, textural, wheat.

I. INTRODUCTION

Noodles are made from unleavened dough, they are extrudates or strands cut from sheets of dough, with flour, water and either common salt as basic ingredients. They are staple food throughout South East Asia but have become accepted and popular in many countries including Nigeria. Noodle consumption takes about 40% of the total wheat produced in the Asian countries [1]. Affordability, bearable taste, minimum cooking time and convenience accounts for the success of noodles all over the world. However, the major component of instant noodles, wheat flour is high glycemic index (GI). Increase tendency of diabetes and obesity had been associated with increased consumption of carbohydrate rich food, especially those with high Glycemic index [2], [3]. There has also been claims that noodles lack other essential nutritional composition such as dietary fiber, vitamins especially B group vitamins and minerals which were lost during wheat flour refinement. Wheat flour has been widely utilized in the processing of alimentary pastes which includes macaroni, spaghetti and other noodle forms [4].

Plantain (Musa spp) is famously consumed as sweet dishes, or as compliments of cereals like rice or legumes like beans or tubers like yam [5]. The southern region of Nigeria, comprising the states of Rivers, Cross River, Akwa-Ibom, Delta, Edo, Enugu, Ogun, Osun, Oyo and Lagos states [6]. More so, four main types of plantain are available in Nigeria with distribution strictly based on their bunch characteristics. These are; the horn type, French type, false horn type and false horn type. The false horn type is the most widely distributed because of its ability to tolerate poor soil conditions [7], [8]. Plantain is rich in essential nutrient [9]. It had been reported to contain high carbohydrate and low fat with values of 31 and 0.4%, respectively [9]. It is rich in iron, potassium and calcium with values of 24 mg/kg, 9.5 mg/kg and 715 mg/kg, respectively, but low in sodium content hence recommended for low sodium diets [10]. Although unripe plantain is rich in carbohydrate, its low Glycemic index (GI) has been established hence to reduce post prandial glucose level, diabetics consume unripe plantain meal [11]. The rhizome of the popular ginger species, Zingiber officinalis, is widely used as a spice and food seasoning due to its sweet aroma and pungent taste.

Ginger is a very important cash crop in Nigeria. Among other spices (pepper and onion) it is the one grown on a commercial scale for export and is highly valued in the...
international market for its aroma, pungency and high oleoresin (gingerol) content [12]. It is well known to have antioxidant activity [13] and effective antimicrobial agents. A ginger rhizome extract exhibited the highest antioxidant activity [14] due to the effect of its total phenols [15]. Texture and colour characteristics are key quality parameter that influences noodle acceptability [16] because of its visual impact and appearance at the point of sale. These qualities provide indication of the nature and form of raw materials used in the product. Earlier report showed that customers prefer bright yellow noodles that retain a stable colour for 24–48 h after preparation [17]. Texture and colour assessment is essential as it influences product acceptability [18]. Consequently, this work was aimed at evaluating the physicochemical properties, textural and sensory characteristics of noodles produced from wheat and unripe plantain flours composite, spiced with ginger.

II. MATERIALS AND METHODS

A. Materials

Unripe plantain and ginger were obtained from Igbo Etche market, Port Harcourt. Hard Wheat Flour was obtained from Pure Flour Mills Choba, Port Harcourt, Nigeria. Alkaline salts, table salt, guar gum and riboflavin were obtained from Dufil Prima Foods PLC Choba, Port Harcourt. Refined Bleached De-odorized palm oil (RBDPO) was obtained from dufil Prima Foods PLC, Port Harcourt.

B. Production of Plantain Flour

The unripe plantain fruits were peeled manually with the aid of a stainless steel kitchen knife and the pulp was sliced into 1.5 mm thickness and blanched in 0.5% sodium metabisulphite solution for 10 min, after which, it was drained and oven dried at 75 °C for 6 hours in a P SELECTA air dry oven. The dried plantain slices were then grinded using a domestic electric blender and then sieved through a 250 µm mesh using RETSCH AS 200 sieve shakers. Using the procedure of Kiin-Kabari et al. [19].

C. Production of Ginger Power

The ginger samples were peeled manually with the aid of a stainless-steel kitchen knife and the pulp was sliced into 1.5 mm thickness and oven dried at 40 °C for 12 h in a P SELECTA air dry oven. The dried ginger slices were then grinded using a domestic electric blender and then sieved through a 250 µm mesh using RETSCH AS 200 sieve shakers. Using the procedure of Kiin-Kabari et al. [19].

D. Processing of Wheat, Plantain Flour and Ginger Powder Blends into Fried Noodles

The method described by Nagoa [20] was used to process the flour blends into noodles with slight modification as shown in Fig. 1. Two hundred (200) grams of the various flour samples was mixed with 33% distilled water, 1.5% NaCl, 0.1% K2CO3, 0.1% Na2CO3, and 0.003% riboflavin. The resultant dough was knead in a mortar using a pestle for 5 min and allowed to rest for 20 ml for proper gluten development, then folded and extruded with a noodle making machine (Eurosomic Pasta/Noodle making machine) with the roller gap set at 4 mm during the 1st sheeting, then 2 mm and lastly, final dough sheet thickness of 1.4 mm. The sheet was slitted into strands of diameter 1.4 mm thickness. The noodle strands were steamed to gelatinization for 90 s and fried in a deep fat fryer at 150 °C for 120 s, packed and vacuum-sealed in high density polyethylene film and preserved for further analyses. The combination of hard wheat flour, plantain flour and ginger powder are shown in Table I.

![Fig. 1. Processing Wheat, Plantain flour and ginger powder into Instant noodles](image)

E. Colour Characteristics

The color of noodle samples was measured with a Chromameter (Minolta, Tokyo, Japan) equipped with a D65 illuminant using the CIE L*a*b* system. The L*, a* and b* readings were obtained directly from the instrument and provided measures of lightness, redness and yellowness, respectively.

- L* = (100 to 0) White to black
- a* = (+60) Red colour
- = (0) neutral
- = (-60) Green colour
- b* = (+60) yellow colour
- = (0) neutral
- = (-60) Blue colour

F. Proximate Composition

Moisture, Ash, fat, Crude fiber, protein and carbohydrate content were determined using AOAC [21] standard procedures.

G. Cooking Time

The procedure described by Ojure and Quadri [1] was used to determine the cooking time. In 300 ml of deionised water was cooked 10 g of noodles using a 500 ml covered beaker.
Cooking time was determined by the removal of a piece of noodle every 2 min and pressing the noodle between 2 pieces of watch glasses. Optimum cooking was achieved when the when the noodle was fully hydrated or when the center of the noodles became transparent.

H. Cooking Loss

The procedure described by Ojure and Quadri, [1] was used to determined cooking loss. In 300 ml of deionised water was cooked 10 g of noodles using a 500 ml covered beaker. Cooking continue until the central opaque core in the noodle strand disappeared. Cooking loss (%) was evaluated by draining the excess water from the cooked noodles and transferring the water to a pre-weighed beaker, evaporating the water in a conventional oven for 24 h at 100 °C, then reweighing the beaker with left over solids. All analyses were performed in triplicate.

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\text{Cooking Loss} (\%) = \frac{\text{dried residue in cooking water}}{\text{Weight of noodle sample before cooking}} \times 100
\]

I. Water Absorption

Water absorption (%) was determined according to the procedure described by Ojure and Quadri, [1]. Cooked noodles were rinsed with water and drained for 30 s then weighed to determine the gain in weight. This analysis indicates the amount of water absorbed by the noodles during cooking process.

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\text{Water absorption} (\%) = \frac{\text{WC}}{\text{WD}} \times 100
\]

\(\text{WC} = \text{Weight of cooked instant noodle in g}\) and 
\(\text{WD} = \text{Weight of dried instant noodle in g}\)

J. Texture Profile Analysis (TPA)

TPA was performed following the procedure described by Hou [22]. Using a texture analyzer (TA. XT Plus®, Stable Micro Systems Ltd., Surrey, UK). Noodle was boiled until the noodle was fully hydrated or when the central opaque core in the noodle strand disappeared. Texture loss (%) was evaluated by draining the excess water from the cooked noodles and transferring the water to a pre-weighed beaker, evaporating the water in a conventional oven for 24 h at 100 °C, then reweighing the beaker with left over solids. All analyses were performed in triplicate.

\[
\text{Texture Analysis} (\%) = \frac{\text{dried residue in cooking water}}{\text{Weight of noodle sample before cooking}} \times 100
\]

K. Sensory Evaluation

Sensory evaluation was done using the procedure described by Chinma et al. [23]. Trained fifteen panelists were used from the Food Quality Control and Assurance Department of Dufil Prima Foods PLC (Producer of Indomie Instant Noodle), Port Harcourt, Nigeria. Coded noodle samples were evaluated for texture, taste, appearance, aroma, colour, flavour and overall acceptability. Each sensory attribute was rated on a 9-point Hedonic scale (1 = disliked extremely to 9 = liked extremely).

L. Statistical Analysis

All experiments and analysis were carried out in triplicates. The mean and standard deviation values were calculated. Data were subjected to Analysis of Variance (ANOVA). Means were separated using Duncan multiple comparison test, and significance accepted at P<0.05 level. The statistical package in SPSS version 26.0 was used.

III. RESULTS AND DISCUSSION

A. Colour Characteristics

The results showed that as the amount of unripe plantain flour increased, the appearance of the fried noodles became darker, as seen in Fig. 2. According to Mohamed et al. [24], the darkness of the fried instant noodles supplemented with unripe plantain flour was probably due to Maillard reaction between reducing sugars and proteins presence in the flour blends. There was significant difference (p<0.05) in the L*, a* and b* values of wheat-plantain ginger noodles with exception of b* value samples WPGF2 and WPGF3. L* values of wheat-plantain composite noodles decreased significantly (p<0.05) with increase substitution of plantain flour (Table II). A similar trend in L*, a* and b* values for raw sheet noodles and optimally cooked noodles supplemented with banana flour had been reported [25]. Noodle colour is a key quality characteristic [16] because of the visual impact during sales. It gives a hint on raw material quality and in some cases, product age. Asian noodle color may be white or yellow depending upon the noodle type, but it should be bright [26]. Specifications for noodle color and texture vary by noodle type [26]. Preferred characteristics are determined by consumer desires and expectations in each market [26]. Factors that control noodle colour stability have been extensively studied and they include flour refinement, alkaline formulation and enzymatic browning due to polyphenol oxidase [27]. Some customers prefer bright yellow, alkaline noodles that retain a stable color for 24–48 h after preparation and consider red or dull grey noodles as undesirable [17].

### TABLE II: COLOUR CHARACTERISTICS OF INSTANT NOODLES PRODUCES FROM WHEAT AND PLANTAIN FLOUR BLENDS, SPICED WITH GINGER

| Treatments | L*   | a*   | b*   |
|------------|------|------|------|
| WF         | 77.23±0.02 | 0.56±0.01 | 22.93±0.06 |
| WPGF1      | 71.65±0.06 | 1.88±0.02 | 24.62±0.02 |
| WPGF2      | 66.60±0.08 | 3.27±0.02 | 20.36±0.00 |
| WPGF3      | 63.44±0.28 | 4.10±0.07 | 20.35±0.07 |
| WPGF4      | 59.61±0.12 | 4.65±0.02 | 19.05±0.02 |
| WPGF5      | 57.06±0.05 | 6.16±0.02 | 19.59±0.02 |

Values are means ± Standard Deviation of triplicate determinations. Means in the same column with different superscript are significantly different at P<0.05.

B. Proximate Composition of Noodles

From the results (Table III), moisture content ranged from 7.33–10.70%, with significant differences (p<0.05) noticed in mean moisture of samples WPGF1 and WPGF2, there was no significant difference (p>0.05) in moisture content of samples WPGF3, WPGF4 and WPGF5. The result obtained differs
with that of Pitiporn et al. [25] which showed decrease in moisture content with increased banana flour substitution. The moisture content of all the noodle samples were within codex standard moisture specification of 10 % (maximum) for instant fried noodles [28].

This implied that the products will have reasonable shelf stability. Low moisture content enhances the keeping properties of food products because it prevents the growth of micro-organisms [29]. The crude protein content ranged from 7.33% to 10.70% with sample WF giving significantly p<0.05 higher value of 10.70 %. This showed that increasing substitution with unripe plantain flour reduced the crude protein content of the instant noodles. Percentage protein corroborated with the report of Adebayo et al. [30], but lower compared to 11.66–12.51% and 14.29–14.9% reported for sweet potato-wheat instant noodles [31], and defatted rice bran-soybean-wheat noodle [32], respectively. Ash content of the noodles increased significantly with increase substitution of unripe plantain flour across all the treatments, but there was no significant difference (p>0.05) in the ash content of WPGF1 and WPGF2 and that of samples WPGF2 and WPGF3. The percentage ash content corroborated with 0.6% to 1.2% reported earlier by Sanni et al. [33] for instant noodles produced with cassava and wheat flour blend. It also corroborated with 1.54% ash content of instant noodles produced from corn, tapioca and wheat flour blends [32]. Percentage ash content any food showed the amount of minerals contained in that food [34]. The ash results obtained were similar with those recorded by earlier researchers [35]. Percentage crude fiber increased with increase substitution of unripe plantain flour. The control sample gave 0.40% crude fiber, which was significantly (p<0.05) lower, while crude fiber content of instant noodles produced with 50% substituted unripe plantain flour showed significantly (p<0.05) higher crude fiber of 1.13%. This result corroborated with the increasing trend earlier recorded by Adebayo et al. [30]. The crude fiber content of the noodles corroborated with values of 0.2 % to 0.8% given earlier by Sanni et al. [33] for noodles produced from cassava and wheat flour blend. The crude fiber content also corroborated with values of 0.54 to 0.58% reported by Taneya et al. [31] for instant noodles produced with sweet potato and wheat flour blends. Crude fiber had been reported to interfere with the release of glucose from the colon into the blood stream and this result in a decrease in inter colonic pressure, by this phenomenon the risk of colon cancer is reduced [36].

There was increase in fat content of the fried noodles across the treatments however, no significant difference (p>0.05) was noticed amongst WF and WFI, WFI and WPGF2, WPGF2 and WPGF3, and WPGF3 and WPGF4. The increased percentage fat of the fried noodle was due to absorption of fat during deep frying. Percentage fat content of the fried instant noodles corroborated with 11.1% to 18.4% reported by Sanni et al. [33] for noodles produced from cassava and wheat flour blend. It was however, higher than values of 5.3% to 6.25% and 4.98 % reported earlier by Taneya et al. [31] for instant noodles produced from sweet potato and wheat flour blends and noodles produced from blends of corn, tapioca and wheat flour [32]. Fat content of (10.0–16.54%) has been reported for fried noodles from soybean-wheat composite flour [37]. All the fried noodle samples recorded fat contents that were within instant noodle specification (20% maximum) approved by Nigerian Industrial Standards [38]. It is however important to note that fried noodles contain about 15–20% oil and are more susceptible to oxidation resulting in rancidity [37].

| TABLE III: PROXIMATE COMPOSITION OF INSTANT NOODLES PRODUCED FROM WHEAT AND PLANTAIN FLOUR BLENDS, SPEICED WITH GINGER |
|-----------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Treatments                       | Crude Protein (%) | Fat (%)          | Ash (%)          | Moisture (%)   | Crude Fiber (%) | CHO (%)          |
|-----------------------------------|-------------------|------------------|------------------|----------------|----------------|-----------------|
| WF                                | 10.70±0.14        | 16.01±0.92       | 1.18±0.09        | 6.44±0.05      | 0.40±0.03       | 65.27±0.93       |
| WPGF1                             | 10.05±0.03        | 16.91±0.51       | 1.47±0.10        | 6.29±0.09      | 0.46±0.03       | 64.83±0.65       |
| WPGF2                             | 9.92±0.08         | 17.28±0.41       | 1.75±0.13        | 6.87±0.12      | 0.54±0.07       | 63.64±0.36       |
| WPGF3                             | 8.61±0.02         | 17.50±0.34       | 2.04±0.16        | 7.95±0.04      | 0.66±0.04       | 63.25±0.40       |
| WPGF4                             | 7.72±0.02         | 18.39±0.22       | 2.32±0.20        | 7.74±0.11      | 0.89±0.10       | 62.93±0.13       |
| WPGF5                             | 7.33±0.02         | 19.75±0.48       | 2.61±0.24        | 7.66±0.45      | 1.13±0.11       | 61.53±0.17       |

Values are means ± Standard Deviation of triplicate determinations. Means in the same column with different superscript are significantly different at P<0.05. WF = Wheat flour (100:0:0); WPGF1 = Wheat flour/plantain flour/Ginger Powder (90:10:4); WPGF2 = Wheat flour/plantain flour/Ginger Powder (80:20:4); WPGF3 = Wheat flour/plantain flour/Ginger Powder (70:30:4); WPGF4 = Wheat flour/plantain flour/Ginger Powder (60:40:4); WPGF5 = Wheat flour/plantain flour/Ginger Powder (50:50:4).
Carbohydrate content of the noodles ranged from 61.53% to 65.27% with the control showing higher value of 65.27%, while WPGF5 composite noodle had the lowest carbohydrate content (61.53%). There was a significant difference (p ≤ 0.05) in the carbohydrate content of the WPGF1 and WPGF2 as well as WPGF4 and WPGF5 but no significant difference among WPGF2, WPGF3, and WPGF4 noodles. The carbohydrate content of unripe plantain–wheat instant noodles was lower than 70.39% to 73.80% and 68.30% represented for sweet potato–wheat noodles [31], and corn–tapioca–wheat instant noodles [32], respectively.

C. Cooking Properties of Noodles

Results for the cooking time, cooking loss and water absorption of noodles produced with wheat and plantain flour blends, spiced with ginger are shown in Table IV. The cooking time ranged from 4.40 mins (WF noodles 100:0) to 3.28 min. (WPGF5 composite noodles 50:50). Optimum Cooking time refers to the time in minutes to gelatinize the starch marked by disappearance of central white core in the noodles strand [39]. The results indicated that the cooking time decreased with the increase in unripe plantain composite flours; there was significant (p<0.05) difference in the cooking time among the treatments. The decrease in cooking time might be due to the dilution of gluten in dough as reported by earlier researchers [40]. This might be due to discontinues gluten chain, a phenomenon that weakens the dough structure [41], [42]. Result for cooking time of instant noodle produced from unripe plantain and wheat flour corroborated with 3.11 to 4.77 min reported by Purwandari et al. [43] for instant noodles produced from bread fruit, konjac-pumpkin and wheat flour blends, but lower than 4.5 to 8.29 min for instant noodles produced with plantain and wheat flour. The cooking time was also lower than 4.3 to 5.41 min and 5.6 to 6.6 min reported earlier for instant noodles produced from corn, tapioca and wheat and those produced with malted and fermented cowpea and wheat flour, respectively [1], [44], [45].

| TABLE IV: COOKING QUALITIES OF INSTANT NOODLES PRODUCED FROM WHEAT AND PLANTAIN FLOUR BLENDS, SPICED WITH GINGER |
|---------------------------------------------------------------|
| **Treatments** | **Cooking Time (m)** | **Cooking Loss (%)** | **Water Absorption (%)** |
|----------------|----------------------|----------------------|-------------------------|
| WF             | 4.40±0.04            | 5.92±0.05            | 9.82±0.37               |
| WPGF1          | 4.22±0.03            | 6.71±0.03            | 10.67±0.27              |
| WPGF2          | 4.08±0.02            | 7.57±0.05            | 11.87±0.32              |
| WPGF3          | 3.56±0.03            | 8.36±0.03            | 12.50±0.40              |
| WPGF4          | 3.49±0.03            | 9.22±0.05            | 13.00±0.35              |
| WPGF5          | 3.28±0.02            | 10.01±0.03           | 13.15±0.19              |

Values are means ± Standard Deviation of triplicate determinations. Means in the same column with different superscript are significantly different at P<0.05.

The result shows that there were significant (p<0.05) differences in the cooking loss among all the noodle samples. The cooking loss ranged from 5.92 to 10.01 g with the control 100:0 and WPGF5 composite noodle 50:50 having the least and highest values respectively. The relatively high cooking loss of sample WPGF5 (50:50 composite noodle) was probably due to poor network of protein matrix resulting from low protein content, especially the gluten-forming proteins (glutenin and gliadin) [42]. These results compared favourably with earlier report on pasta quality produced by completely substituting durum wheat semolina with higher fiber material. Cooking loss was shown to increase with increase substitution of unripe plantain flour, as the non-gluten protein in plantain flour allowed higher incidence of solids leaching into the cooking medium from the noodles [47].

Water absorption capacity ranged from 9.82–13.15%, increasing with increased substitution of plantain flour. Water absorption capacity showed the ability of the noodle to absorb water during cooking and this is an important characteristic in deciding the cooking quality [48]. The control (WF) noodle 100:0 had the least water absorption (9.82) while sample WPGF5 had the highest water absorption (13.15). The addition of unripe plantain flour may have probably enhanced the interaction between starch granules and protein matrix of the resultant noodles. Increase in water absorption across sample treatments could be attributed to the relative higher fiber content of the sample [40].

D. Texture Profile of Noodle

It is generally accepted that texture is the main criterion for assessing overall quality of cooked noodles [49]. From the result in Table V, hardness ranged from 11919–23771 g. The addition of unripe plantain flour resulted in significant change (p<0.05) in the hardness of noodles when compared to the control WF. There was however, no significant difference between sample WPGF1 and WPGF2, and samples WPGF3, WPGF4 and WPGF5. The values obtained for hardness increased across the treatments. Similar increasing trend was for noodles enriched with apple pomace, due to high fiber content [50]. Unripe plantain like apple pomace, rich in fiber. This may account for the increased noodle hardness. However, this did not agree with Makhlof et al. [51], who reported that fiber-enriched formulations had lower firmness (hardness). Positive effect of protein content on hardness of cooked noodles had been reported [52].

Adhesiveness ranged from -255.81 to 153.06 g.s, and reduced with increased substitution of unripe plantain flour. Springiness was not affected with increased unripe plantain flour across the various treatments. There was also no significant difference (p>0.05) among the control WF, WPGF1 and WPGF2. Springiness is how well a product physically springs back after it has been deformed. It indicates the degree of recovery after the first bite [53].

There was no significant difference (p<0.05) in cohesiveness of noodle samples between the control WPG (100:0:4), WPGF1 (90:10:4), WPGF2 (80:20:4) and WPGF3 (70:30:4). Cohesiveness indicates the Strength of internal bonds in the noodle samples [54]. There was no significant difference (p<0.05) in the gumminess of noodles from various treatments when compared to the control (WF) except for samples WPGF4 (60:40:4) and WPGF5 (50:50:4). Both samples are not significantly different from one another. Gumminess is derived by the multiplication of Hardness with Cohesiveness [53]. There was no significant difference (p<0.05) in chewiness of noodles compared to the control (WF). Chewiness is derived by the multiplication of Gumminess with springiness. Resilience force increased with increase substitution of plantain flour.
TABLE V: TEXTURE PROFILE OF INSTANT NOODLES PRODUCED FROM WHEAT AND PLANTAIN FLOUR BLENDS, SPICED WITH GINGER

| Treatments       | Hardness (g.s) | Adhesiveness (g.s) | Springiness (%) | Cohesiveness (%) | Gumminess (%) | Chewiness (%) | Resilience (%) |
|------------------|----------------|--------------------|-----------------|------------------|---------------|---------------|---------------|
| WF               | 11919.09±0.90  | -53.06±1.66        | 0.85±0.07       | 0.51±0.02        | 6078.77±0.06  | 5187.23±0.87  | 0.27±0.04     |
| WPGF1            | 15390.34±1.47  | -184.24±3.87       | 0.79±0.11       | 0.51±0.02        | 7452.27±0.97  | 6210.20±1.50  | 0.32±0.03     |
| WPGF2            | 15769.97±1.19  | -196.45±3.06       | 0.70±0.13       | 0.47±0.04        | 7789.52±1.08  | 5319.64±1.48  | 0.32±0.03     |
| WPGF3            | 20547.83±1.27  | -199.08±5.98       | 0.68±0.09       | 0.46±0.04        | 8049.60±1.09  | 5048.81±1.45  | 0.34±0.05     |
| WPGF4            | 21995.23±3.65  | -222.45±9.71       | 0.65±0.08       | 0.42±0.03        | 10036.51±1.50 | 6865.67±1.44  | 0.35±0.02     |
| WPGF5            | 23771.82±2.78  | -255.81±5.93       | 0.62±0.10       | 0.39±0.04        | 10149.98±2.03 | 6576.71±1.48  | 0.36±0.04     |

Values are means ± Standard Deviation of triplicate determinations. Means in the same column with different superscript are significantly different at P<0.05.

WF = Wheat flour (100:0:0); WPGF1 = Wheat flour/plantain flour/Ginger Powder (90:10:4); WPGF2 = Wheat flour/plantain flour/Ginger Powder (80:20:4); WPGF3 = Wheat flour/plantain flour/Ginger Powder (70:30:4); WPGF4 = Wheat flour/plantain flour/Ginger Powder (60:40:4); WPGF5 = Wheat flour/plantain flour/Ginger Powder (50:50:4).

### TABLE VI: SENSORY CHARACTERISTICS OF INSTANT NOODLES PRODUCED FROM WHEAT AND PLANTAIN FLOUR BLENDS, SPICED WITH GINGER

| Treatments       | Appearance | Aroma | Flavour | Taste | Texture | Colour | Overall Acceptability |
|------------------|------------|-------|---------|-------|---------|--------|-----------------------|
| WF               | 7.20±1.78  | 7.40±1.35 | 8.47±0.74 | 7.33±1.29 | 7.67±1.11 | 7.53±1.36 | 7.80±1.01          |
| WPGF1            | 7.67±1.44  | 7.40±1.50 | 8.40±0.82 | 7.40±1.12 | 7.60±1.06 | 7.27±1.87 | 7.60±1.18          |
| WPGF2            | 5.87±0.99  | 6.47±1.36 | 8.07±0.80 | 6.67±1.29 | 6.53±1.23 | 5.93±1.62 | 6.47±0.83          |
| WPGF3            | 4.40±1.30  | 5.27±1.39 | 7.73±0.59 | 5.33±1.50 | 6.00±1.31 | 5.13±1.55 | 5.33±1.04          |
| WPGF4            | 4.13±1.55  | 5.20±1.32 | 6.27±0.96 | 4.80±1.93 | 5.53±1.51 | 4.53±1.13 | 5.27±1.22          |
| WPGF5            | 3.40±1.88  | 4.27±2.19 | 5.07±1.44 | 4.73±2.34 | 5.00±1.96 | 3.47±1.68 | 4.80±1.52          |

Values are means ± Standard Deviation of triplicate determinations. Means in the same column with different superscript are significantly different at P<0.05.

E. Sensory Properties of Noodles

From Table VI, scores for appearance ranged from 3.40 to 7.20. Average values recorded on appearance are comparatively higher than those reported for ginger spiced cookies produced from wheat and plantain composite flour [55]. Scores for aroma ranged from 4.27 to 7.40. The control noodle sample (100% wheat noodle) had the highest score for aroma 7.40 while the 50:50 composite noodle (WPGF5) recorded the lowest value 4.27.

Aroma score of 7.40 for 100% wheat flour noodle was higher than 6.6 reported earlier for noodles produced from blends of wheat, acha and soybean composite flours [42]. This may be attributed to the incorporation of ginger powder in the composite flours which is rich in oleoresin [42]. Improved aroma of noodles with dried unripe banana composite flour had earlier been reported [56]. Flavour scores for samples WF, WPGF1, WPGF2 and WPGF3 were not significantly different (p>0.05). The 8.47 average flavour value obtained for sample WF (100% wheat noodle) was higher than 6.70 to 7.60 recorded by Akajiaku et al. [57] for 100% wheat noodle. Taste, texture and colour scores ranged from 4.73–7.33, 5.00–7.67 and 3.47–7.53, respectively. The variation in taste could be probably due to variation in noodle flour composition [56]. The relatively low texture scores obtained as unripe plantain flour increases was probably due to interference of the composite flour constituents in gluten development. Significant differences noticed in texture scores of the instant noodles was probably due to elastic dough structure resulting from presence of gluten-rich wheat flour. Noodles that has better structure and textural characteristics had been associated to presence of gluten-rich characteristics [42]. Similar trend in texture has been reported for the cooking quality. Sensory properties and Textural characteristics of noodles produced from blends of Wheat and Musa Spp flours [30].

The colour scores for noodles produced from 100% wheat flour and that produced from 10% substituted unripe plantain flour were not significantly different (p>0.05).

Colour scores reduced with increased substitution of plantain flour, probably due to panelist familiarity with conventional commercial noodle colour. Colour is a key quality variable that influence consumer choice and acceptability of food products [42]. It influences purchasing decisions of its consumers. Overall acceptability scores were shown to range from 4.80 to 7.80 with noodle substituted with 10% plantain flour receiving equal acceptability as the control.

IV. CONCLUSION

This study showed that noodles produced with substitution of unripe plantain flour increases in Ash, fat and crude fiber content. Increased substitution of plantain flour reduced Cooking time from 4.40 to 3.28 m, while the water absorption capacity increased. Hardness, gumminess and chewiness also increased. Sensory attributes Appearance, aroma, flavor, texture, taste and colour for instant noodles produced from 100 %wheat flour and those substituted with 10 % unripe plantain flour were not significantly different. Overall acceptability of the instant noodle products ranged from 4.80–7.80% with noodle substituted with 10 % plantain flour receiving equal acceptability as the control.

CONFICT OF INTEREST

Authors declare that they do not have any conflict of interest.

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