Asian Journal of Advanced Research and Reports

Volume 18, Issue 6, Page 41-53, 2024; Article no.AJARR.114080
ISSN: 2582-3248

Assessing the Quality and Potential of Fried Noodles: An Analysis of Wheat and *Afzelia africana* Flour Blends in Chemical, Functional, Physical, and Sensory Dimensions

Ernest Eguono Emojorho [a*], Marian Reuben-Okoye [b], Agnes Aphiar [c], Adaora Ngozi Nwosu [d], Maryann Nkemakonam Anene [e], Eseoghene Avbundiogba [f] Titus Onucheojo Ochimana [g] and Lauretta D. Ekpekpo [h]

[a] Department of Food Science and Technology, Delta State University of Science and Technology, Ozoro, Delta State, Nigeria.
[b] Industrial Safety & Environmental Management Technology, Delta State School of Marine Technology, Burutu, Nigeria.
[c] Department of Microbiology, Delta State University of Science and Technology, Ozoro, Delta State, Nigeria.
[d] Department of Food Science and Technology, University of Nigeria, Nsukka, Nigeria.
[e] Department of Food Science and Technology, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria.
[f] Enviromental Management and toxicology, Delta State University of Science and Technology, Ozoro, Delta State, Nigeria.
[g] Department of Food Science and Technology, University of Nigeria, Nsukka, Enugu State, Nigeria.
[h] Department of Chemistry, Delta State University of Science and Technology, Ozoro, Nigeria.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJARR/2024/v18i6652

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/114080

**Corresponding author: E-mail: emojorhoeguono@yahoo.com;*

Original Research Article

Received: 03/02/2024
Accepted: 07/04/2024
Published: 17/04/2024

ABSTRACT

Afzelia africana flour was produced by roasting, dehaulling and grinding seeds into flour. In this study, the chemical composition, functional, physical properties and sensory characteristics of fried noodles produced from wheat and *Afzelia africana* (Akpalata) flour blends were evaluated. Wheat and *Afzelia africana* flours was blended in the ratio of 100:0(WFO), 95:5(WFAA1), 90:10(WFAA2), 85:15(WFAA3) and 80:20(WFAA4) as 100% wheat flour was used as the control. Samples were used to produce fried noodles. The functional qualities of flour mixes were examined. The noodles samples underwent physical, chemical, and sensory investigation. The noodle sample was cooked and sensory evaluation carried out. Result of proximate composition of the noodles ranged from (crude protein; 23.00- 30.05 crude fat; 10.00- 14.7%, ash; 0.95- 3.00%, crude fibre; 1.10- 2.95%, moisture; 7.50-9.00%, and carbohydrate; 50.00-53.11%) respectively. Functional results showed 0.64 to 0.66 g/cm3, 14.00 to 20.00 % oil absorption capacity, 25.20 to 36.50 ml swelling capacity and 21.00 to 25.90 % water absorption capacity. Physical properties results showed 11.65 – 12.75 cm length and 0.26 – 0.43 cm. The sensory scores showed that sample WFAA4 (80:20) was the most overall acceptable by the judges. In conclusion, acceptable noodles with improved protein content and reduce processing cost can be produced from blends of wheat and *Afzelia africana* flours.

Keywords: Afzelia africana; flour; chemical; physical; noodle; functional.

1. INTRODUCTION

Made from unleavened dough and additional ingredients, instant noodles are long, thin pieces of food [1]. Gelatinization and dehydration, which are accomplished by either frying or drying, are its defining characteristics [2]. Noodles have gained popularity all over the world due to its taste, nutrition, ease of use, safety, extended shelf life, and affordable pricing. Another use for noodles is as an emergency food. Worldwide, noodles are the second most popular food after bread in terms of consumption [3]. Some of these noodles, which have recently gained popularity in western nations, are typically produced from rice, potato starches, buckwheat, and mug beans (Fu, 2018). Noodle manufacture in Asia uses about 40% of wheat flour [4].

One of the most significant cereals for human consumption is wheat (*Triticum spp*.), which is used to make a wide range of foods and beverages, including flour, breads, cookies, cakes, biscuits, macaroni, spaghetti, and noodles. Because of the climate, wheat is not grown in Nigeria. Usually, imports cost enormous sums of money. As a result, Nigeria is pushing the use of flour blends to limit the import of wheat and boost the production of goods and crops enhanced with protein. Composite flour, also known as flour blends, is a combination of flours used to partially or completely replace wheat flour in baked goods or pastries [5]. In order to encourage the use of local crops and lessen wheat imports, flour blends are highly desired in developing nations. Cereal-legume-based diets are one of the most readily available sources of nutritional energy and minerals worldwide. Cereal cannot provide all of the nutrients required for a balanced diet on its alone. Legumes, which are nutritional supplements to a cereal-based diet and comprise beans, black gram, pigeon pea, etc, which complete the amino acid profile. Cereal is high in cysteine and methionine, but it lacks some necessary amino acids, such as lysine, and hence cannot provide all of the nutrients required for optimal nutrition [6,7]. The usage of composite flour can assist minimize wheat imports for the production of food products such as baked goods, as well as reduce reliance on wheat imports, conserve foreign exchange, and productively employ our youth. [8]. Emojorho et al [6] revealed that composite flour with debittered orange seed flours were highly rich in minerals when compared to whole wheat flour. Typical low glycemic index (GI) foods are legumes.

Legumes include a lot of carbohydrates, but they also contain a lot of resistant starch and dietary fiber, which are good for preventing postprandial glucose increase since they are not absorbed or digested. Legumes are a great source of nutrients since they are high in proteins, minerals, and photochemicals such polyphenols [9]. Moreover, compared to wheat gluten, the proteins in legumes have a better amino acid score and a lower likelihood of triggering allergy disorders [10]. Ayanwale [11] states that the majority of *Afzelia africana* (Akparata) plant cultivation occurs in the Savannah, adjacent forests, and drier areas of Africa's forest zones. According to Akajiaku et al. [12], it is a member of the subfamily *caesalpinaceae* and the family *Leguminosae*. In Nigeria, the Hausa, Yoruba, Igbo, and Fulani speaking regions refer to it as kawo, apa, akpalata, and gayoki, respectively. The seeds, like melon and Irvingia gabonensis seeds, have a waxy in nature, orange cup-like shape at the base and are often used as a thickening factor in Nigerian soups. A portion of wheat flour can be replaced with cheap, locally sourced legumes, such as *Afzelia africana* (Akparata) flour, without negatively impacting the goods' appeal. Afzelia *africana* flour can partially replace wheat flour in recipes to boost nutritional content overall, support the agriculture industry, expand the variety of noodles available, lessen reliance on wheat flour for noodle manufacture, and cut production costs. One of the most important issues facing tropical developing nations is protein energy malnutrition. This is primarily due to the population's constant growth and growing reliance on a diet high in cereals. Because of their makeup, noodles are rarely consumed by elderly individuals. Crude fat and carbohydrates are more abundant in noodles. Body aging results in less efficient protein digestion. They therefore need diets high in protein. This study's objectives were to make noodles from wheat and *Afzelia africana* (Akparata) flour mixtures and assess the chemical composition, functional, physical and sensory properties.

2. MATERIALS AND METHODS

Purchasing of raw materials: In Aninri LGA, Enugu state, Nigeria, Okpanku local market was the source of *Afzelia africana* (Apkarata) seeds. We bought wheat flour and other supplies from the Ogige market in Nsukka, Enugu state, Nigeria.

Preparing flour from *Afzelia africana* (Apkarata): After sorting the seeds of *Afzelia africana*, extraneous elements were eliminated. They were first roasted for one hour at 160° in a locally built roaster, then they were dehulled, ground into flour using a hammer mill, and sieved through a 7µm sieve size. Before being analyzed, the flour was kept at room temperature and sealed in an airtight container. Fig. 1 depicts the flour's production.

2.1 Composite Flour Formulations for Instant Noodles

The wheat and *Afzelia africana* flour blends will be mixed in the ratio of 100:0, 80:20, 60:40, 40:60, 20:80 and 0:100 respectively.

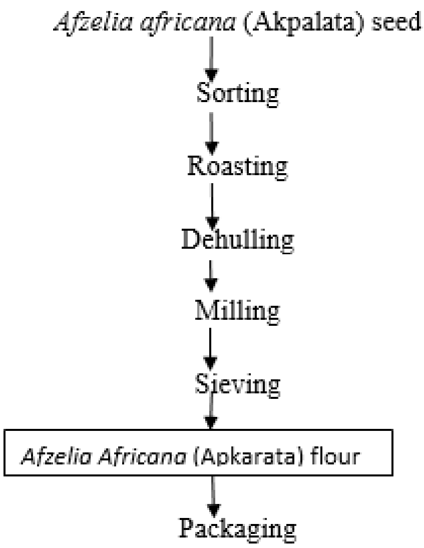

Fig. 1. Processing of *Afzelia africana* (Apkalata) flour

Table 1. Composite flour formulation for instant noodles

Samples	Wheat flour	*Afzelia africana* flour
WFO	100	0
$WFAF_1$	80	20
$WFAF_2$	60	40
$WFAF_3$	40	60
$WFAF_4$	20	80

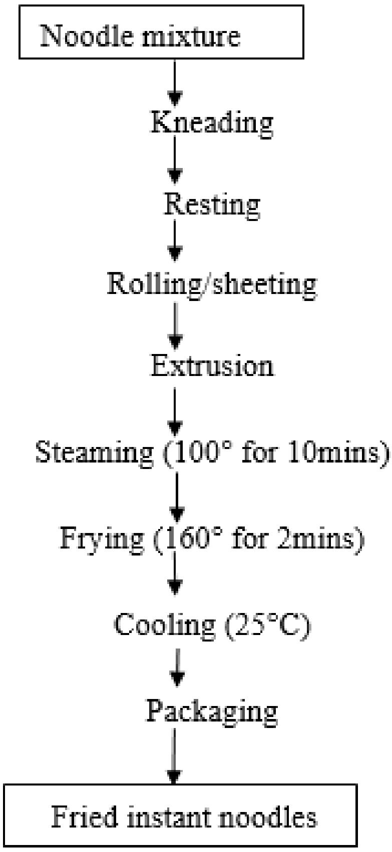

Fig. 2. Production of fried noodles
Source: Neelam et al. [13]

2.2 Production of Noodles from Blends of Wheat Flour and *Afzelia africana* (Akparata) Flour

With minor adjustments, noodles were made using the procedure outlined by Neelam et al. [13]. The flour blends were combined in various proportions, as indicated in Table 1, with tap water (65 ml/100 g of total weight) and common salt (2 g/100 g of flour). After an hour of rest, the dough was flattened into a sheet that was roughly 5 mm thick. Using a manual noodle maker, the dough sheet was continuously rolled until it reached a thickness of 1.3 to 1.0 mm. From there, it was extruded into noodle strands. The noodles were deep-fried in vegetable oil at 140–160°C for two minutes after being cooked for ten minutes at 100°C and then cooled to 25°C. After the fried noodles had reached room temperature, they were wrapped in plastic wrap. The flow diagram for production of noodles is shown in Fig. 2.

Functional properties of flour and blends: The flour and blends were examined for their functional qualities, such as least gelatine content, bulk density, swelling capability, oil absorption capacity, and water absorption capacity, using the techniques outlined by

Onwuka [14].The procedure outlined by Onwuka [14] was used to calculate the bulk density. The method outlined by Onwuka [14] was used to calculate the oil absorption capacity. Onwuka's [14] approach was used to determine the product's swelling capacity. Water absorption capacity was calculated by applying the Onwuka [14] method.

Physical properties: The noodles' length and width have been defined as their physical characteristics. By measuring three noodles strands using the meter rule (cm) and calculating the average, the length of the noodles was ascertained. Using a vernier calliper to measure the width of three noodles strands and calculating the average, the width of the noodles was ascertained.

Chemical properties: The proximate (moisture content, ash content, crude fiber, crude fat, crude protein, and carbohydrate content) of the noodles made from the flour mixes were examined. The A.O.A.C. [15] was followed in determining the moisture content. The A.O.A.C. [15] method was utilized to ascertain the product's ash content. We calculated crude fiber by applying the methodology outlined by A.O.A.C. [15]. The soxhlet extraction method, as outlined by A.O.A.C. [15], was used to calculate crude fat. The semi-micro kjeldahl flask was used to measure the crude protein content of the sample, and 3.0g of hydrated cupric sulphate (catalyst) was added to the flask. Using A.O.A.C. [15]'s approach, the sample's carbohydrate content was ascertained by difference.

calorific value determination: A.O.A.C. [15] describes how the Atwater factor was used to determine the energy value of the samples based on the data received from the analysis of protein content, fat content, and carbohydrate content.

$$\text{Calorific value}\left(\frac{\text{Kcal}}{100\text{g}}\right) = \text{P} * 4.0 + \text{F} * 9.0 + \text{C} * 3.75 \qquad (1$$

Sensory evaluations: Twenty man semi-trained panels consisting of University of Nigeria Nsukka (UNN) Department of Food Science and Technology students evaluated the noodles based on their sensory qualities. A 9-point Hedonic scale [16] was used to rate the samples' color, flavor, texture, aftertaste, and general acceptability. A score of 9 indicates an extreme like, whereas a score of 1 indicates an extreme dislike.

3. RESULTS AND DISCUSSION

Production of instant noodles from blends of wheat flour and *Afzelia africana* (Akparata) flour.

Plate 1. *Afzelia africana* (Akparata) seed

Plate 2. *Afzelia africana* (Akparata) flour

Plate 3. WFO (100 % wheat and 0% *Afzelia africana* (Akparata) flour

Plate 4. $WFAF_1$ (95 % wheat and 5% *Afzelia africana* (Akparata) flour

Plate 5. $WFAF_2$ (90% wheat and 10% *Afzelia africana* (Akparata) flour

Functional properties of flour blends: The functional properties of flour blends of wheat and *Afzelia africana* (Akparata) flour are as shown in Table 1.

Bulk density: The samples WFAF4 (80% wheat and 20% *Afzelia africana*) had the maximum bulk density while sample WFO (100% wheat and 0% *Afzelia africana*) had the lowest bulk density. The bulk densities of the flour blends ranged from 0.64g/cm3 to 0.66g/cm3 (Table1), which was within the range of 0.42 – 0.77g/cm3 bulk density of composite flours reported by Anene et al., [8] and 0.36 – 0.698 g/cm^3 bulk density of defatted orange seed flour reported by Emojorho and Okonkwo, (2022) but lower than 0.511 to 0.878 of undefatted orange seed flours reported by Emojorho and Okonkwo [17]. The bulk density rose as the amount of flour made from *Afzelia africana* increased. The high fiber content of the flours may be the cause of the flour blends' high bulk densities. In the food sector, high bulk density is important for application, handling of raw materials, and packaging. (Unidentified, 2021).

Oil absorption capacity: The same factors that impact the water absorption capacity also affect the oil absorption capacity. Sample WFAF4 (80% wheat and 20% *Afzelia africana*) had the greatest value and sample WFO (100% wheat and 0% *Afzelia africana*) had the lowest oil absorption capacity. The values varied from 14% to 20% (Table 1). An increase in Afzelia africana flour was found to increase the oil absorption capacity. Protein conformation, surface polarity, hydrophobic properties, and amino acid composition are examples of intrinsic elements that affect a dietary protein's ability to bind water and oil [18].

Water absorption capacity: A product's water absorption capacity is an indicator of its ability to bind to water in situations where water availability is restricted. The mix WFAF4 with (80% wheat and 20% Akparata) *Afzelia africana* flour has the highest water absorption capacity, whereas the other flour blends ranged from 21% to 25%. Sample WFO (100% wheat and 0% Akparata) had the lowest value. Protein's potential to absorb water is necessary for a wide range of food items, including soups, dough, as well as food that is baked [19]. As the amount of *Afzelia africana* flour increased, so did its capacity to absorb water. The protein and fiber content of *Afzelia africana* flour may be the cause of this. Hatcher et al. [4] state that the distribution of milled flour particle sizes influences the processing rate of hydration because flours with very fine particle sizes are more likely to absorb water during hydration.

Swelling capacity: The flour blends had a capacity to swell ranging from 25.40ml to 36.50ml. Sample WFO (100% wheat and 0% akparata) had the maximum swelling capacity, while sample WFAF4 (80% wheat and 20% akparata) had the lowest. The swelling capacity reduced as the percentage of *Afzelia africana* flour increased, which may have been caused by the kind, size, and processing technique of the flour.

Physical characteristics of instant noodles made from wheat flour along with *Afzelia africana* (Akparata) flour blends: Table 2 displays the physical characteristics of the noodles made using blends of wheat flour and *Afzelia africana* (*akparata*) flour. The noodles samples ranged substantially in length ($p<0.05$), ranging from 11.65cm to 12.75cm. The maximum value is found in sample WFAF1 (95% wheat and 5% akparata), while the lowest value is found in sample WFAF3 (85% wheat and 15% akparata). Because the samples' wheat flour had a high gluten concentration, they were strong and elastic and did not break readily. Regarding the noodle samples, there was no significant ($p>0.05$) difference. This is most likely the result of the finishing rolls in the sheeting and cutting part of the machine being left at a constant distance from one another during production.

Proximate composition (%) of instant noodles made with wheat with *Afzelia* africana (Akparata) flour blends: Table 3 illustrates the proximate composition of instant noodles made with wheat and also *Afzelia africana* (Akparata) flour combinations.

Moisture content: The instant noodles' moisture content varied from 7.50% to 9.00%, with sample WFO (100 percent wheat and 0% akaparata) having the highest value and samples WFAF1 (95 percent wheat and 5 percent akaparata) and WFAF4 (80 percent wheat and 20 percent akaparata) having the lowest values. The fried noodles' maximum analytical moisture requirement of 10% was not met by the moisture content. The product's stability during storage will be improved by its low moisture content.

Ash content: With sample WFAF4 (80% wheat and 20% akparata) having the highest value and sample WFO (100% wheat and 0% akparata) having the lowest, the ash content of the noodles ranged from 0.95% to 3.00%. As the amount of *Afzelia africana* (Akparata) flour added to the wheat flour grew, so did the ash content of the noodles. This might be because *Afzelia africana* (Akparata) flour contains certain minerals.

Crude fibre: The instant noodles' crude fiber content varied from 1.10% to 2.95%, with sample WFAF4 having the highest value and sample WFO having the lowest. The value were within the range of 1.50 to 1.86 % crude fibre for composite flours reported by Anene et al. [8] but lower than 6.68 to 24.59 % reported by Emojorho and Okonkwo, [17] for debittered orange seed flours. The high value of crude fiber with sample WFAF4 is most likely a result of the higher inclusion of the high-fiber *Afzelia africana* flour.

Crude fat: With sample WFAF4 (80% wheat and 20%) having the highest value and sample WFO (100% and 0% Akparata) having the lowest, the crude fat content of the instant noodles ranged from 9.00% to 14.70. This is most likely a result of the high fat content of the *Afzelia africana* (Akparata) flour that was added.

Second, during the frying process, lipid replaced the moisture in the steamed noodles, increasing the instant noodles' fat content. The noodles' flavor will be improved by the fat content. It does, however, expose the product to oxidative rancidity.

Table 2. Functional properties of flour blends of wheat and *Afzelia africana* (Akparata) flour

Sample	Bulk Density (g/cm3)	Oil Absorption Capacity (%)	Swelling Capacity (ml)	Water Absorption Capacity (%)
WFO	0.66 ^{d}±0.00	14.00^{a}±0.00	35.95^{d}±0.07	23.20^{c}±0.14
$WFAF_1$	0.64^{a}±0.00	15.00^{a}±0.70	30.50^{b}±0.14	21.30^{a}±0.14
$WFAF_2$	0.64^{b}±0.01	18.00^{b}±0.00	25.40^{a}±0.14	21.00^{a}±0.00
$WFAF_3$	0.65^{b}±0.00	19.00^{c}±1.41	36.50^{e}±0.14	22.20^{b}±0.14
$WFAF_4$	0.65^{c}±0.00	20.00^{c}±0.00	32.13^{c}±0.00	25.90^{d}±0.14

Values are mean ± SD of duplicate determinations. Mean within a column with the same superscript were not significantly (p>0.05) different

Key: WFO= 100% Wheat flour, $WFAF_1$= 95% wheat and 5% Afzelia africana flour, $WFAF_2$= 90% wheat and 10% Afzelia africana flour, $WFAF_3$= 85% wheat and 15%Afzelia africana flour, $WFAF_4$= 80% wheat and 20% Afzelia africana flour

Table 3. Physical properties of instant noodles from wheat flour and *Afzelia africana* (Akparata) flour blends

Samples	Length (cm)	Thickness (cm)
WFO (100:0)	12.15^{c}± 0.34	0.43±0.02
$WFAF_1$ (95:5)	12.75^{ab} ± 0.34	0.38± 0.01
$WFAF_2$ (90:10)	11.85^{c} ± 0.71	0.30 ± 0.00
$WFAF_3$ (85:15)	11.65^{d} ± 0.95	0.28 ± 0.00
$WFAF_4$ (80:20)	12.10^{d} ± 1.27	0.26 ± 0.07

Values are mean ± SD of duplicate determinations. Mean within a column with the same superscript were not significantly (p>0.05) different

Key: WFO = 100% wheat flour, $WFAF_1$= 95% wheat and 5% Akparata flour, $WFAF_2$= 90% wheat and 10% Akparata flour, $WFAF_3$= 85% wheat and 15% Akparata flour, $WFAF_4$= 80% wheat and 20% Akparata flour

Crude protein: The instant noodles' protein contents varied from 14.0% to 30.5%, the result were similar to 8.64% – 31.81 % protein reported by Emojorho and Akubor, (2016) for debittered orange seed flours. The samples with the highest and lowest protein contents are WFAF4 (80% wheat and 20% akparata) and WFO (100% wheat and 0% akparata). The protein content increased gradually as the amount of *Afzelia africana* (Akparata) flour increased. These might result from the flour's high *Afzelia africana* (Akparata) concentration.

Carbohydrate: With sample WFAF4 (80% wheat and 20% akparata) having the highest value and sample WFO (100% wheat and 0% akparata) having the lowest, the carbohydrate content of instant noodles ranged from 44.49% to 54.60%. Because *Afzelia africana* flour was added, sample WFAF4, which is composed of 80% wheat and 20% akparata, has a high carbohydrate content.

Cooking characteristics of instant noodles from wheat and *Afzelia africana* flour: Table 5 shows the cooking characteristics of instant noodles made from blends of wheat and *Afzelia africana* flour.

Cooking yield: Food weight variations brought on either moisture loss or water absorption are referred to as cooking yield. Adding more *Afzelia africana* flour had a substantial (p<0.05) impact on the cooking yield. A decreased cooking yield was obtained with a higher proportion of *Afzelia africana* flour. The samples WFO (100% wheat and 0% akparata) had the greatest mean score of 91.50% to 96.00%, whereas sample WFAF4 (80% wheat and 20% akparata) had the lowest mean score.

Cooking loss: The amount of solid ingredients lost in the cooking water is measured by cooking loss. The range of the cooking loss was 5.15% to 8.14%, in that order. Cooking loss increased as the amount of *Afzelia africana* flour increased. According to Setyani et al. [20], the variation in cooking loss may be caused by the raw material's amylose content, most likely wheat flour. The stronger the gel structure generated and the smaller the cooking loss of the noodles, the greater the amylose level. The samples with the highest values were WFAF4 (80% wheat and 20% akparata) and WFO (100% wheat and 0% akparata).

Table 4. Proximate composition (%) of instant noodles formulated from wheat and *Afzelia africana* (Akparata) flour blends

Samples	Moisture	Ash	Crude Fibre	Crude Fat	Crude Protein	Carbohydrate
WFO	8.00^{a}±0.00	0.95^{a}±0.07	1.10^{a}±0.14	10.00^{a} ± 0.00	14.00^{a}± 0.00	48.16^{a}± 0.01
$WFAF_1$	8.00^{a}±0.14	2.60^{b} ± 6.50	1.55^{b}±0.07	12.50^{b}± 0.00	18.26^{b}± 0.09	48.16^{a}± 0.01
$WFAF_2$	9.00^{a}±0.00	1.75^{b}±0.35	2.00 ^{c}± 0.00	13.45^{c}± 0.70	25.70^{c}± 0.14	50.00^{a} ± 0.00
$WFAF_3$	7.50^{a}±0.70	2.40^{c}±0.14	2.40^{d}± 0.14	13.50 ^{c}± 0.00	29.01^{d}± 0.01	53.11^{b}± 0.16
$WFAF_4$	7.50^{a}±0.70	3.00^{c}±0.00	2.95^{e}± 0.07	14.70 ^{d}± 0.14	30.05^{e}± 0.07	54.60^{b}± 6.50

Values are mean ± SD of duplicate determinations. Mean within a column with the same superscript were not significantly (p>0.05) different

Key: WFO= 100% Wheat flour, $WFAF_1$= 95% wheat and 5% Afzelia africana flour, $WFAF_2$= 90% wheat and 10% Afzelia africana flour, $WFAF_3$= 85% wheat and 15%Afzelia africana flour, $WFAF_4$= 80% wheat and 20% Afzelia africana flour

Table 5. The cooking characteristics of instant noodles made from blends of wheat and *Afzelia africana* flour

Samples	Cooking yield (%)	Cooking loss (%)	Optimum cooking time (min)
WFO	$96.00^{a} \pm 0.01$	$5.15^{d} \pm 0.21$	$11.50^{c} \pm 0.71$
$WFAF_1$	$94.00^{b} \pm 0.00$	$5.95^{c} \pm 0.14$	$10.00^{b} \pm 0.00$
$WFAF_2$	$92.00^{b} \pm 0.28$	$4.20^{c} \pm 0.01$	$11.50^{b} \pm 0.28$
$WFAF_3$	$92.00^{c} \pm 0.14$	$6.14^{c} \pm 0.02$	$9.00^{d} \pm 0.00$
$WFAF_4$	$91.50^{c} \pm 1.71$	$8.14^{b} \pm 0.01$	$11.00^{c} \pm 0.05$

Values are mean ± SD of duplicate determinations. Means within a column with the same superscript were not significantly (p>0.05) different

Key: WFO = 100% wheat flour, $WFAF_1$= 95% wheat and 5% Afzelia africana flour, $WFAF_2$= 90% wheat and 10% Afzelia africana flour, $WFAF_3$= 85% wheat and 15%Afzelia africana flour, $WFAF_4$= 80% wheat and 20% Afzelia africana flour

Optimum cooking time: The amount of time needed for the opaque core of pasta to vanish is known as the optimal cooking time [21]. Sample WFO (100% wheat and 0% Akparata) had the maximum optimal cooking time of 11:50 minutes, which was substantially (p<0.05) different from the other samples. This may be explained by the flours' ability to store water and high fiber content. According to Omerie et al. [22], the cooking times of the samples are similar to those of noodles made from groundnut, soybean, wheat, melon seed, and Bambara nut flours.

3.1 Sensory Properties of Instant Noodles

Table 6 shows the mean of sensory scores of noodles samples from blends of wheat and *Afzelia africana* flour.

Colour: The noodles sample WFO (100% wheat and 0% Akparata) had the lowest level of preference, whereas the noodles sample WAFA1 (95% wheat and 5% Akparata) was ranked highest. Important elements influencing noodle color include yellow pigment, flour color, protein concentration, ash content, and polyphenol oxidase activity. Because *Afzelia africana* flour contains polyphenols, the noodle samples made with this flour had a creamy color [23]. The acceptance of the noodles was influenced by their creamy color.

Flavour: The noodles from mixes have a flavor sensory score ranging from 5.45 to 6.90. In comparison to sample WFO (100% wheat and 0% Akparata), sample WFAF4 (80% wheat and 20% Akparata) had the highest value. There was no discernible difference in the samples' flavors (p>0.05). The flavor of the noodles' *Afzelia africana* (Akparata) flour contributed to the variation in preferences. The product's flavor was positively impacted by the flavor of *Afzelia africana* (Akparata) flour [24].

Taste: Noodles made with flour mixtures have flavors ranging from 5.45 to 6.90. Sample WFO, which contains 100% wheat and 0% Akparata, was ranked lowest, whereas sample WFAF4, which contains 80% wheat and 20% Akparata, had the greatest value. Taste preference was seen to rise as more *Afzelia africana* (Akparata) flour was added. Ejikeme et al. [25] speculate that this is most likely due to the flavor and taste of *Afzelia africana* (Akparata) flour.

Mouth feel: Noodles had a mouthfeel that varied from 4.90 to 6.15. While the value of noodle sample WFO (100% wheat and 0% Akparata) was lowest, that of noodle sample WFAF4 (80% wheat and 20% Akparata) was greatest. A substantial difference (p<0.05) was seen in the mean scores of the noodles from the blends. The preference for mouthfeel was observed to rise as more *Afzelia africana* (Akparata) flour was added. This is most likely due to *Afzelia africana* (Akparata) flour's stabilizing properties. The amount of protein in noodles has a positive correlation with their hardness and occasionally a negative correlation with their flexibility.

Aftertaste: The noodles' aftertaste values varied from 5.23 to 5.90. The highest value was recorded for noodle sample WFAF4 (80% wheat and 20% Akparata), while the lowest value was recorded for noodle sample WFO (100% wheat and 0% Akparata). There was no significant difference (p>0.05) in the aftertaste preferences between the noodles samples.

Overall acceptability: Noodles from the blend were generally accepted in a range of 5.30 to 6.10. The values of samples WFO (100% wheat and 0% Akparata) and WFAF4 (80% wheat and 20% Akparata) were greatest and lowest, respectively. The samples WFO (100% wheat and 0% Akparata) and WFAF4 (80% wheat and 20% Akparata) differed significantly (p<0.05).

Table 6. Shows the mean of sensory scores of noodles samples from blends of wheat and *Afzelia africana* flour

Sample	Colour	Flavour	Taste	Mouth Feel	Aftertaste	Overall Acceptability
WFO.+32	$7.20^{a} \pm 0.89$	$5.90^{a} \pm 1.11$	$5.45^{a} \pm 0.99$	$4.90^{a} \pm 0.96$	$5.28^{a} \pm 0.91$	$5.30^{a} \pm 0.73$
$WFAF_1$	$7.35^{a} \pm 0.74$	$6.00^{a} \pm 0.91$	$6.00^{ab} \pm 0.91$	$2.54^{ab} \pm 1.05$	$5.60^{a} \pm 0.99$	$5.55^{ab} \pm 0.88$
$WFAF_2$	$7.20^{a} \pm 0.61$	$6.05^{a} \pm 0.68$	$6.00^{ab} \pm 0.72$	$5.65^{ab} \pm 0.98$	$5.30^{a} \pm 0.57$	$5.50^{ab} \pm 0.76$
$WFAF_3$	$7.20^{a} \pm 0.61$	$6.25^{a} \pm 1.16$	$6.40^{b} \pm 1.23$	$5.85^{b} \pm 1.30$	$5.40^{a} \pm 1.14$	$5.65^{ab} \pm 1.08$
$WFAF_4$	$7.30^{a} \pm 0.47$	$6.45^{a} \pm 1.23$	$6.90^{c} \pm 1.11$	$6.15^{b} \pm 1.45$	$5.90^{a} \pm 1.33$	$6.10^{b} \pm 1.07$

Values are mean ± SD of duplicate replications. Mean within a column superscript were not significantly (p<0.05) different

Key: WFO= 100% Wheat flour, $WFAF_1$= 95% wheat and 5% Afzelia africana flour, $WFAF_2$= 90% wheat and 0% Afzelia africana flour, $WFAF_3$= 85% wheat and 15%Afzelia africana flour, $WFAF_4$= 80% wheat and 20% Afzelia africana flour

Furthermore, there was no significant difference ($p>0.05$) between samples WFAF1, WFAF2, and WFAF3 [26,27,28].

4. CONCLUSION

Based on the research, the chemical, cooking, and sensory qualities of the noodles were found to be impacted by the addition of *Afzelia africana* (Akparata) flour to wheat flour when making noodles. The noodles' protein content was greatly raised by combining flour with *Afzelia africana* (*Akparata*) flour. Therefore, mixtures of wheat and *Afzelia africana* flours can be used to generate acceptable noodles with improved protein content with lower cost of production. The physical characteristics of the noodles demonstrated that the addition of *Afzelia africana* (Akparata) flour to wheat flour during the noodle-making process acted as a stabilizer and binder, keeping the noodles from clinging to one another and shattering.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Taneya MLJ, Biswas MMH, Shams-ud-Din M The studies on the preparation of instant noodles from wheat flour supplementary with sweet potato flour. Journal of Bangladesh Agricultural University. 2014; 12(1):135.
2. WINA (World instant noodles association). What is instant noodles; 2021. Available:http//instantnoodles.org/en/noodles/faq.html (Accessed on 1st September 2021).
3. Yadav BS, Yadav RB, Kumari M, Khatkar BS. Studies on suitability of wheat flour blends with sweet potato, colocasia and water chestnut flours for noodle. LWT-Food Science and Technology. 2014; 1(57):352-358.
4. Hatcher DW, Bello GG, Anderson MJ. Flour particle size, starch damage, and alkali reagent: impact on uniaxial stress relaxation parameters of yellow alkaline noodles. Cereals Chemistry. 2019;86: 361-368.
5. Suresh Chandra, Samsha Singh, Durvesh Kumai. Evaluation of functional properties of composite flours and sensorial attributes of composite flour biscuit. Journal of Food Science and Technology. 2014;52(6):1.
6. Emojorho EE, Anene MN, Chiedu UC. Effect of debittering methods on the minerals composition of sweet orange seeds flour. Food Proc Nutr Sci. 2023a; 3(1):1-7.
7. Anene MN, Emojorho EE, Chiedu UC, Anyaiwe UC Rheological, micronutrients and microbial quality of idli produced from blends of rice (*Oryza sativa*), African yam bean (*sphenostylis sternocarpa*) and pigeon pea (cajanus cajan). Global scientific Journals. 2023b;11(11): 1941-1962.
8. Anene MN, Emojorho EE, Chiedu UC, Anyaiwe UC. Chemical functional physical and sensory properties of flour and idli produced from blends of rice (*Oryza sativa*), African yam bean (*Sphenostylis sternocarpa*) and pigeon pea (*Cajanus cajan*). Horticult Int J. 2023; 7(4): 149–157. DOI: 10.15406/hij.2023.07.00289
9. Polak R, Phillips EM, Campbell A. Legumes: Health benefits and culinary approaches to increase intake. Journal of Clinical Diabetology. 2015;1(33):198–205.
10. Mathai JK, Liu Y, Stein HH. Values for digestible indispensable amino acid scores (DIAAS) for some dairy and plant proteins may better describe protein quality than values calculated using the concept for protein digestibility-corrected amino acid scores (PDCAAS). British Journal of Nutrition. 2017;117:490–499.
11. Ayanwale. Effect of raw and roasted wild *Afzelia africana* seed meal based diets on broiler chickens. International Journal of Poultry Science*.* 2017;6(1):27-30.
12. Akajiaku LO, Nwosu JN, Kabuo NO. Using sorghum flour as part of wheat in noodles making. Journal of Food Processing Technology. 2017;5(2):250-257.
13. Neelam Gulia, Vandana Dhaka, Khatka BS. Instant noodles: Processing, quality, and nutritional aspect. Critical Reviews in Food Science and Nutrition. 2014;54(10): 1386-1390.
14. Onwuka GI. Food analysis and instrumentation. Theory and Practice (2nd Edition) Naphthali prints, Lagos Nigeria. 2018;62.
15. AOAC. Official methods of analysis. Association of official Analytical chemist official methods of analysis, 18th

edition, Washington D.C, United States of America; 2010.
16. Ihekoronye AI, Ngoody PO. Intergrated food science and technology for the tropics. Macmillian Publishers, London. 1985;345-360.
17. Emojorho EE, Okonkwo TM. Effect of debittering methods on the chemical and physiochemical properties of defatted and undefatted sweet orange seed flours. Fruits. 2022;77(6):1-10.
18. Kaushal P, Kumar V, Sharma HK. Comparative study of physic-chemical functional properties of Taro (*Colocasia esculenta*), Rice (*Oryza sativa*), pigeon pea (*Cajanus cajan*) flour and their blends. LWT-Food Science and Technology. 2012;48:59-68.
19. Adeyeye IE, Aye PA. Chemical composition and the chemical effect of salts on the food properties of *Triticum durum* whole meal flour. Pakistan Journal of Nutrition. 2018;4(3):187-196.
20. Setyani SJ, Sussi A, Florentina. Substitute of corn tempe flour on wet noodles. Journal of Food Technology. 2017;22(1): 1-10.
21. Zhongquan S, Peter WL, Harold C. Optimal cooking time of Noodles related to their notch sensitivity. Journal of Texture Studies. 2016;37(4):428-441.
22. Omeire GC, Umeji OF, Obasi NE. Acceptability of noodles produced from blends of wheat, acha and soybean composite flours. Nigeria Food Journals. 2015;2(32):31-37.
23. Egwujeh SID, Ariahu CC, Orishagbemi CO. Effects of processing variables on chemical compositions of African oak (*Afzelia africana*) seed. International Journal of Agricultural and Veterinary Sciences. 2016;2(2):73- 82.
24. Nwajinka CO, Onuegbu CU, Ameefule DO. Emperical study of the characteristics of *Afzelia africana* seed under compressive loading. Nigeria Journal of Food Technology. 2017;36(3):97-100
25. Ejikeme PM, Obasi LN, Egbuonu ACC. Physico-chemical and toxicological studies on *Afzelia africana* seed and oil. African Journal of Biotechnology. 2012;9(13): 1959-1963.
26. Emojorho Anonymous. Composite flour definition; 2021. Available:https://www.google.com (Accessed on 6th October 2021)
27. Emojorho EE, Okonkwo TM, Eze JI. Chemical physical shelf-life and sensory properties of biscuits produced from defatted and undefatted debittered orange seed flours. Fruits. Art. Fruits. 2023b;78(1):02.
28. Hatcher DW. Asian noodle processing. In: Cereals Process, Technology, (Owens, G.ed.). Woodhead Publishing Limited, Cambridge, UK. 2021;131-157.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/114080