Acta Scientific NUTRITIONAL HEALTH (ISSN:2582-1423)

Volume 6 Issue 8 August 2022

Review Article

Quality Characteristics and Consumer Acceptability of Noodles Produced from Wheat Flour Fortified with Kidney Bean (*Phaseolus Vulgaris* L.) Flour

Adegbanke Omolara R*, Olowoofoyeku, Deborah G and Liasu-oni Gbohunmi E

Federal University of Technology, Akure, School of Agriculture and Agricultural Technology, Department of Food Science and Technology, Akure, Ondo State, Nigeria

***Corresponding Author:** Adegbanke Omolara R, Federal University of Technology, Akure, School of Agriculture and Agricultural Technology, Department of Food Science and Technology, Akure, Ondo State, Nigeria.

DOI: 10.31080/ASNH.2022.06.1113

Received: June 22, 2022

Published: August 08, 2022

Abstract

Noodles are made from white flour which has lost some nutrients during wheat flour refinement, it is therefore necessary to fortify noodles with protein rich ingredients which will enhance the nutritional value. The major raw materials Wheat Flour (WF) and Kidney Beans were gotten from Erekesan market, Akure, Ondo State. This study is aimed at fortifying noodles made from wheat with kidney bean flour (KBF). WF and KBF were formulated into ratios at different proportions of HBA 80:20 (Wheat: kidney bean flour); GCB 70:30 (Wheat: kidney bean flour); FDC 60:40(Wheat: kidney bean flour) and EED 50:50 (Wheat: kidney bean flour). The formulated blends were used in producing noodles which were evaluated for proximate analysis, mineral determination, noodle cooking quality, amino acid profile and sensory evaluation using commercial instant noodles as control. The proximate composition result showed that the protein, ash and fat contents were higher in the formulated samples than in the control sample. Sample EED had 22.93% protein and was significantly different ($p < 0.05$) from the control (10.21%). The protein and fat contents increased while carbohydrate decreased with increase in the incorporation of kidney bean flour to the blend. The mineral composition (Na, Ca and Zn) showed that there was significant difference ($p > 0.05$) in the formulated samples while Cd and Pb were not detected in the samples. Noodle cooking quality presented sample FDC with the least coking loss value and Amino acid results Leucine and Isoleucine values to range from (5.663-7.685g/100g) and (2.349-3.887g/100g) respectively. The result of the sensory evaluation is based on a nine-point hedonic scale which presented that generally apart from the control, noodles from FDC 60:40 (wheat: kidney bean) had the overall acceptability followed by GCB 70:30, HBA 80:20 and EED 50:50 respectively.

Keywords: Noodles, Kidney Beans, Consumer Acceptability

Introduction

To address the growing concern of food insufficiency due to wastage as well as population increase worldwide, some methods have been established as solutions to achieving food security including genetic modification of crops to increase yield, development of storage and processing methods to reduce postharvest losses of horticultural produce and value addition via processing and product development to increase the utilisation of under-utilised and neglected edible food crops amongst others [1].

Noodle, a pasta product mainly made from flour, water, salt and is popular in the Chinese cuisine, in recent times has increased consumption worldwide because of the globalisation of trade, quick cooking time, convenience, palatability, shelf stability and affordability [1,10]. Noodles are mainly made by a process of mixing raw materials, dough sheeting, compounding, sheeting/rolling and cutting of dough, which allows lower water addition as compared with other bakery products, different types of noodles are made by varying the properties of the flour, type of salt, the manufacturing processes and further processing of the noodle strands coming out of cutting rolls [8]. Noodles are made from white flour which has lost some nutrients during wheat flour refinement in contrast to pasta products made from coarse semolina milled from durum wheat by extrusion [8,10]. However, to enhance diversification, value addition, use of under-utilised produce, researchers have produced noodles using composite flours from wheat and other flours like cowpea flour, soybean flour, lentil seed flour, breadfruit flour amongst others and the inclusions of these ingredients enhanced some nutritional parameters as well as consumer acceptability [1,2,15].

Legumes like red kidney beans are rich in bioactive nutrients that can be incorporated into the diet. The red kidney beans alongside other beans such as pinto beans, navy beans and black beans are known scientifically as *Phaseolus vulgaris* and so named for its similar appearance in shape and colour to the human kidney organ. It is Known as *"Ndudu brown*" in Igbo, *"Papala"* in Yoruba and it contains high amounts of dietary fibre, starch, vitamins, minerals as well as an extensive array of phytochemicals but the most important component of nutritional significance is their high protein content which is 2-3 times that of cereal grains [9]. The inclusion of legumes in food products helps to improve the diet pattern of consumers as some do not consume these ordinarily and it also provides a good and non-expensive source of protein in the diets [11]. This study is being carried out to use red kidney bean flour as a good and non-expensive source of protein to fortify the wheat flour used for noodle production. Effect of replacement levels on noodle nutritional parameters, cooking quality and sensory characteristics were studied. The general objective of this study is to determine the quality characteristics and consumer acceptability of noodles fortified with red kidney bean flour.

Materials and Methods

Wheat flour, red kidney beans and other ingredients were purchased at Erekesan market, Akure, Ondo State. Nigeria. All chemicals used were of analytical grade and purchased from a reputable local chemical store. Table 1 presents the combination of all ingredients.

Sample	Wheat flour	Kidney bean flour	CMC (g)	Salt
HBA	80	20	0.5-1.5	1
GCB	70	30	0.5-1.5	1
FDC	60	40	0.5-1.5	1
EED	50	50	0.5-1.5	1
CON	100	-	-	-

Table 1: Ingredients Combination for Noodles Produced from Kidney Bean and Wheat Flour per 100g.

Keys: HBA-Noodles Produced at 80-20% Flour Formulations, GCB-Noodles Produced at 70-30% Flour Formulations, FDC-Noodles Produced at 60-40% Flour Formulations, EED-Noodles Produced at 50-50% Flour Formulations, CON-Commercial Noodles as Control.

Processing of kidney bean into flour

A modified method of [13] was employed. First, the bean seeds were sorted manually to remove irrelevant materials like dirt, residue, shrivelled and diseased seeds and the healthy ones were used. In the processing of kidney bean flour, dry seeds were soaked for 24h in water. After 2h, the seeds were manually de-hulled to separate the seeds coats from the cotyledon, the de-hulled seeds were dried in the oven at temperature of 65^{o}C for 8 hours before they were ground with an attrition mill. The sample was filtered through a 0.5 mm sieve to get the flour sample for analysis which was stored in an airtight container until further analysis. The flowchart process is presented in figure 1.

Processing of noodles using wheat flour fortified with kidney bean flour

Formulated noodles were prepared using the modified method of [16]. Noodles made from 100% wheat flour was purchased as control samples while experimental samples were prepared using wheat flour replaced with equivalent portion of kidney bean. The replacement concentrations were 20, 30, 40 and 50% based on solid contents. All dry ingredients (wheat flour, red kidney bean flour, CMC) were combined and mixed to produce homogenize mixture, it was then poured in a mixing bowl and mixed with warm water until the dough was formed. The dough was shaped into a ball, wrapped in a plastic film and allowed to rest for 30 min, hand-kneaded for 1 min, divided into portions and sheeted using pasta machine (Atlas 150 Well. A.S.P, Italy) by rolling at position one and then repeated at position three. Subsequently, the sheet of dough was passed through a hand-operated pasta machine which cut the dough into strips of 5 mm width that was hung on glass rods and steamed at 70 ºC. The noodles produced were then transferred to a cabinet dehydrator and dried at 70 ºC for 16h. Thereafter, cooled to room temperature, placed in sealed plastic bags until further analysis. The process flowchart of noodle production is presented in figure 2.

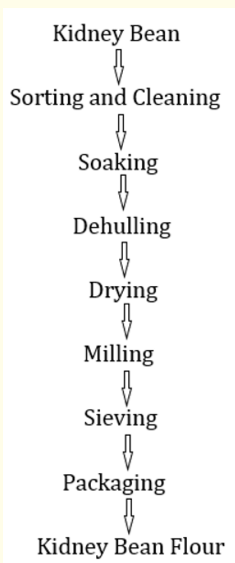

Figure 1: Flowchart Process of Kidney Bean Flour.

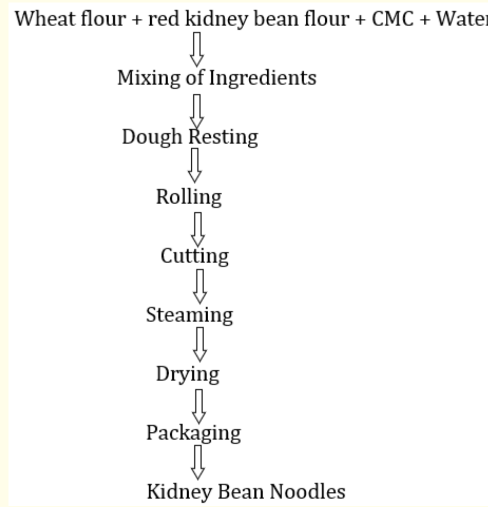

Figure 2: Flowchart Process of Noodles.

Analyses

Proximate analysis of the noodle produced

This analysis involves the determination of the moisture content, ash content, crude fibre crude protein, crude fat and carbohydrate (by difference). The proximate compositions were determined according to the standard method of [5].

Determination of cooking properties/quality of noodles

Cooking time

10 g of noodles were cooked in 200 ml of boiling distilled water in a 250 ml beaker. Noodles were cooked until dissipation of white core, as judged by squeezing in-between two glass slides [18].

Cooked weight

The cooked weight of the noodles was determined as reported by [18]. 10g of noodles were soaked in 300 ml water for 5 min and then cooked in water bath for 5 min. The beaker was covered with aluminium foil to reduce the loss of water due to evaporation. The cooked noodles were drained for about 2 min, rinsed with distilled water in a funnel, and cooked weight was determined by weighing wet mass of noodles.

Cooking loss (g/100g)

The method as reported by [2], was followed. One litre of distilled water was brought to a boil in a 2-liter saucepan with the lid in order to prevent any water loss. When the water started boiling, 100 g portion of the noodles was then added. The cooking temperature (that is the water temperature) was maintained at 98-100 °C throughout the cooking process. The cooking period began once the noodles were put into the boiled water and were cooked for 3 min or until there was no white core was observed after compressing. The noodles were then transferred from the saucepan, rinsed, and then cooled in running cold water for a minute. Cooking loss was measured in terms of the evaporating the cooking water to dryness in oven at 100 °C, as described by the standard method [6].

Water uptake percentage (g/100g)

The water uptake is the difference in the weight of cooked noodle against uncooked noodles, expressed as the percentage of weight of the uncooked noodles. Cooked noodles were rinsed with cold water and drained for 30 seconds thereafter weighed to determine the cooking gain. The analysis states the amount of water absorbed by the noodle during cooking process [18].

Determination of amino acid

The method used for amino acid determination was as reported by [14]. Exactly 20 µg of each samples were dried in conventional hydrolysis tubes. To each tube 100 µL of 6 mol L-1 HCl containing 30 ml phenol and 10 ml 2-mercaptoethanol (6mol L-1 HPME) were added and the tubes were evacuated, sealed and hydrolysed at 110°C for 22h. After hydrolysis, HCl was evaporated in a vacuum bottle heated to about 60°C. The residue was dissolved in a sample buffer and analysed for amino acids using RP-HPLC with an Agilent 1100 assembly system (Agilent Technologies, Palo Alto, CA 94306, USA) and Zorbax 80A C18 column (4.6 id x 180 mm). The Excitation Wavelength (Ex) of 348 nm and Emission Wavelength (Em) of 450 nm were chosen. The column oven was maintained at 60°C. Amounts of amino acids were determined by calculations using the recorded chromatogram. For cystine determination, 50 µg of the formulations were first oxidized with 10 µl performic acid in an ice-water bath for 4h. The mixtures were evaporated with a vacuum pump to remove performic acid before hydrolysis. Determination of tryptophan was done by the ninhydrin method. One gram of each formulation was put into a 25 ml polypropylene test tube with caps, 10 ml of 0.075 N NaOH was added and thoroughly mixed until clear solution was obtained. The dispersion was shaken for 30 min and centrifuged at 5000 rpm for 10 min and the supernatant liquid transferred into a clean test tube. 0.5mL of the supernatants, 5 ml of ninhydrin reagent (1.0g of ninhydrin in 100 ml mixture of 37% HCl and 96% HCOOH) in a ratio of 2:3 for all the samples were added and incubated at 35°C for 2h. After incubation, the solution was cooled to room temperature (23-25°C) and the volumes were made up to 10 ml using diethyl ether, thoroughly mixed using a vortex mixer, filtered and the clear filtrates were analysed with the same equipment as described above for the other amino acids.

Mineral composition

Calcium, Magnesium, and Zinc was determined using Atomic Absorption Spectrophotometer [4]. Sodium and Potassium was determined using Flame Emission Photometer with NaCl and KCl as standards.

Sensory evaluation

Cooked coded noodle samples were presented to twenty [20] panelists and they scored the following attributes: appearance, taste, aroma and overall acceptability of the products using a 9-point hedonic scale, in which 1 represents extreme dislike and 9 represents like extremely. 100% wheat flour noodle was used as control [3].

Statistical analysis

The Data obtained were subjected to one-way analysis of variance (ANOVA) and data were reported as the means ± standard deviations. Comparison of means was done using Duncan's multiple-range test ($p > 0.05$), Statistical Package for Social Sciences (SPSS) software version 17.0 was used to analyse the results of the sensory evaluation.

Results and Discussions

Proximate composition of noodles produced

The result for proximate composition of noodles produced is presented in table 2. The ash content of the samples was generally higher than that of the control which signifies that the samples had higher mineral content than the control which is due to the substitution of wheat flour with varying amounts of red kidney bean flour. The percentage of fat and protein content in the samples vary substantially ($p > 0.05$) from each other as the amount of substitution with red kidney bean flour increased. The results are in line with established reports of works that used legumes for fortification [12,15]. The generally low content of crude fibre in the samples can be attributed to the use of refined wheat flour and de-hulled red kidney bean flour. The carbohydrate content of the samples was also significantly different ($p > 0.05$) with each other. The increase in the percentage of red kidney bean flour added decreases the carbohydrate content of samples made from composite flour in contrast to sample made from 100% wheat flour.

Mineral composition of noodles produced

The result for Mineral Composition for noodles produced is presented in table 3. Mineral composition can be expressed as a chemical formula which simply gives the proportion of different elements and groups of element in the mineral. This result which agrees with [7] showed that Cadmium (Cd), Lead (Pb) and Manganese (Mn) were not detected or were below detection limit, insinu-

Sample	Moisture content (%)	Ash (%)	Crude fibre (%)	Fat (%)	Protein (%)	Carbohydrates (%)
HBA	11.23 ± 0.38[a]	1.94 ± 0.06[a]	0.18 ± 0.01[b]	8.21 ± 0.23[c]	16.03 ± 0.46[d]	62.68 ± 0.47[a]
GCB	11.15 ± 0.21[a]	1.71 ± 0.23[a]	0.18 ± 0.02[b]	9.03 ± 0.61[bc]	19.04 ± 0.38[c]	58.74 ± 0.52[b]
FDC	10.83 ± 0.18[a]	1.81 ± 0.11[a]	0.21 ± 0.01[b]	10.10 ± 0.10[b]	22.48 ± 0.37[b]	54.59 ± 0.76[c]
EED	10.32 ± 0.48[a]	1.77 ± 0.08[a]	0.29 ± 0.01[a]	15.39 ± 0.01[a]	24.29 ± 0.01[a]	48.76 ± 1.40[d]

Table 2: Proximate Composition of Noodles Produced.

Values are means of three replicates ± standard deviation. Mean values followed by different superscripts within columns are significantly different by Duncan's multiple range tests ($p < 0.05$).

Keys: HBA-80-20% Flour Formulations of Noodles Produced**,** GCB - 70-20% Flour Formulations of Noodles Produced**,** FDC-60-40% Flour Formulations of Noodles Produced**,** EED-50 -50% Flour Formulations of Noodles Produced**,** CON-Commercial Noodles.

ating that toxic metals were not present in the sample with respect to Cd, Pb and Mn. Sodium (Na) and Potassium (K) in all the samples were not significantly different but CON had the least value and this showed that incorporation of red kidney bean into the wheat flour increased the nutritional value of the noodles produced. Magnesium, calcium and some other micronutrients are vital elements in some metabolic processes in the body such as in connection with circulatory diseases, calcium metabolism in bone, bone formation, blood clotting, muscle contraction among others [7]. These vital elements are present in the formulated samples in amounts not significantly different from the control sample but in higher amounts in substitutions up to 30%.

Sample	Na	K	Ca	Mg	Mn	Cd	Pb	Zn
HBA	1.27 ± 0.02[a]	1.73 ± 0.21[a]	0.52 ± 0.14[a]	0.35 ± 0.04[a]	ND	ND	ND	0.02 ± 0.01[a]
GCB	1.29 ± 0.16[a]	1.91 ± 0.40[a]	0.62 ± 0.10[a]	0.24 ± 0.12[a]	ND	ND	ND	0.02 ± 0.01[a]
FDC	0.60 ± 0.47[a]	1.13 ± 0.63[a]	0.40 ± 0.20[a]	0.40 ± 0.10[a]	ND	ND	ND	0.02 ± 0.01[a]
EED	1.40 ± 0.20[a]	1.66 ± 0.39[a]	0.63 ± 0.11[a]	0.31 ± 0.10[a]	ND	ND	ND	0.03 ± 0.01[a]
CON	1.24 ± 0.15[a]	1.11 ± 0.24[a]	0.55 ± 0.13[a]	0.39 ± 0.10[a]	ND	ND	ND	0.01 ± 0.01[a]

Table 3: Mineral Composition of Noodles Produced (mg/100g).

Values are means of three replicates ± standard deviation. Mean values followed by different superscripts within columns are significantly different by Duncan's multiple range tests ($p < 0.05$).

Keys: HBA-80-20% Flour Formulations of Noodles Produced**,** GCB-70-20% Flour Formulations of Noodles Produced**,** FDC-60-40% Flour Formulations of Noodles Produced**,** EED-50 -50% Flour Formulations of Noodles Produced**,** CON-Commercial Noodles, ND-Not Detected.

Noodle cooking quality

Result for noodle cooking quality is presented in table 4. Noodle cooking quality is the quality required to ascertain the quality of the noodle which includes the cooking loss and water uptake of the noodles. There were notable differences ($p < 0.05$) observed in the weight of dried noodle, cooking time, cooked weight, cooking loss, and water uptake of the instant noodles evaluated. Noodle of good quality would have a short cooking time and little loss of solids in the cooking water. The cooking time for all noodle sample were significantly ($p < 0.05$) different and higher than that of control (CON) sample and the mean values of the cooking time ranged from 9 - 5, with 50:50 blend noodle sample showing maximum value and control showing the minimum value, indicating that the cooking time increased as the level of inclusion of KBF increased. This result is not in agreement with the findings of [2,18], where the cooking time of three different composite noodle made for sweet potato, colocasia, and water chestnut flour blends and with Modified starch of African Breadfruit were in the range of 6.5 to 8.0 min. Ingredients other than wheat flour, such as KBF, may cause discontinuity in the gluten network resulting in the faster moisture penetration and therefore leading to decreased optimum cooking time. The cooked weight varied from 32.8 g to 45.5 g among the composited noodles. Highest cooked weight (45.5g) value was recorded in the 50:50 blend noodle, while the lowest cooked weight was 32.8 g in the noodle substituted with 20% KBF. Cooking loss values among the noodle samples containing blends of KBF were significantly different in their mean values. The cooking loss ranged from 10.50 to 9.70%, which was more than the value recorded for the cooking loss (7.5%) of the control. This is somehow related to the result of [2]. Cooking loss is point of reference to noodle resistance to cooking, so low levels are preferable. The higher cooking loss in the blend noodles is in agreement with the observations made on noodles prepared with incorporating sweet potato in refined wheat flour and wheat flour blends with sweet potato, colocasia, and water chestnut flours [18]. The water uptake varied from 150.00 to 190.00g/100g, indicating that it increases with increasing level of addition of KBF to the flour blends. The highest water uptake of 190.0g/100g was observed in the case of 50:50 blend noodle and 60:40 blends, whereas 80:20 and 70:30 blend noodle showed the lowest (180.00g/100g) water uptake. Water uptake indicates the degree of noodle hydration and may affect the eating quality of noodles, as inadequate water uptake can lead to producing noodles with hard and coarse texture, and excess water uptake results into soft and sticky noodles [18]. Cooking time, cooked weight, cooking loss, and water uptake of WF-KBF noodles were higher than that of 100% WF (control) sample. These results as opposed to the previously reported relation between cooking loss and water uptake (or water absorption) of noodle where cooking loss negatively correlated to water absorption. It may be an indication of strong structure or more cohesive WF–KBF noodle, as absorption of more water resulted in minimal cooking loss.

Sample	Dried weight of noodles (g)	Cooking time (min)	Cooked weight (g)	Cooking loss (%)	Water uptake/absorption (g/100g)
HBA	150	7	32.8	10.20	180
GCB	150	8	35.1	10.20	180
FDC	170	8	39.8	9.70	190
EED	170	9	45.5	10.50	190
CON	130	5	29.8	7.5	150

Table 4: Noodle cooking quality.

Keys: HBA-80-20% Flour Formulations of Noodles Produced**,** GCB - 70-20% Flour Formulations of Noodles Produced**,** FDC-60-40% Flour Formulations of Noodles Produced**,** EED-50 -50% Flour Formulations of Noodles Produced**,** CON-Commercial Noodles.

Amino acid profile of noodles produced from wheat flour fortified with kidney beans flour

Amino acid profile of the extruded products is presented in table 5. Amino acids are molecules that combines to form proteins. Sample EED with 50% kidney beans flour was higher in glycine, valine and leucine, aspartate, phenylalanine, histidine, tyrosine, cystine and tryptophan compared to other samples. Findings by some authors showed that high leucine might be a factor contributing to the development of pellagra [7]. Therefore, the Leucine - Isoleucine ratios should be considered vital. Result showed that samples contained all essential amino acids which were significantly higher than acceptable standards of recommended daily allowance. It can also be inferred from the table that Glutamate, a non- essential amino acid had higher values in all the samples ranging from (14.465-18.174) and this established for a fact that this particular amino acid can be gotten from the noodles fortified with KBF in higher amount and this function as a major excitatory neurotransmitter in the central nervous system and this can meet demands for certain CNS issues. Therefore, incorporation of raw materials rich in protein leads to noodles with higher and better nutritional values than commercial noodles without it.

Sensory analysis of noodle produced

The result of the sensory analysis is presented in table 6. Sensory evaluation is a science that measures and analyses and interprets the reactions of people to products as perceived by the senses. The results are in accordance with results of [17], the for-

Names	HBA	GCB	FDC	EED
Glycine	2.976	3.271	2.881	4.617
Alanine	6.455	5.463	5.854	3.878
Serine	1.599	2.827	2.512	3.498
Proline	2.059	2.667	2.934	3.033
Valine	2.901	3.572	3.347	4.659
Threonine	3.070	4.019	3.189	4.365
Isoleucine	3.517	2.349	3.143	3.887
Leucine	6.023	5.663	6.507	7.685
Aspartate	8.600	7.546	8.420	8.609
Lysine	2.798	3.279	3.217	4.338
Methionine	8.795	1.346	1.089	1.477
Glutamate	14.465	18.174	15.724	15.566
Phenylalanine	3.513	3.869	4.610	4.732
Histidine	1.333	1.794	1.949	2.294
Arginine	6.134	5.473	6.010	5.783
Tyrosine	2.621	2.812	2.999	3.317
Tryptophan	3.091	1.073	3.644	3.538
Cystine	1.283	1.113	1.251	1.570

Table 5: Amino Acid Profile of Noodles Produced from Wheat Flour Fortified with Kidney Beans Flour.

Keys: HBA-80-20% Flour Formulations of Noodles Produced**,** GCB - 70-20% Flour Formulations of Noodles Produced**,** FDC-60-40% Flour Formulations of Noodles Produced**,** EED-50 -50% Flour Formulations of Noodles Produced**,** CON-Commercial Noodles.

mulated samples had increasing acceptability levels, aroma, taste and appearance until 40% substitute level while the control sample had the highest levels in all parameters and this may be as a result of other ingredients and use of 100% wheat flour for the production of the commercial noodles like stabilizers and emulsifiers that was not used for the formulated samples. There was significant difference ($p > 0.05$) in taste between the control and other samples but there was no significant difference ($p < 0.05$) between formulated samples which could be because of other ingredients used to produce control sample that was not used in producing formulated samples. Noodles produced from 50:50 substitute flour (sample EED) had the least score for all parameters, this might be due to its higher percentage of kidney bean flour which must have resulted to more beany flavour, aroma and colour change in the noodles. Also, the choice of the panellists who were not used to noodles produced from kidney bean because commercially made noodles are normally produced from 100% wheat flour. The overall acceptability result showed significant differences between the noodles ($p > 0.05$). Among the formulated samples, sample FDC (60:40) noodle was the most acceptable and was not significantly different ($p < 0.05$) from noodles produced with wheat and kidney bean in the ratio of 80:20 and 70:30. This signified that noodle produced by substituting part of wheat with kidney bean were also accepted but not totally accepted.

Conclusion

In this research, except for the control, FDC fulfilled almost all analyses carried out followed by GCB, HBA and EED with values 6.15, 5.90, 5.55 and 5.35 respectively. EED has the highest protein content because of the high amount of kidney bean flour in the blend. So, KBF can be used as an underutilized protein source to improve the nutritional quality of noodles and this is beneficial to the health of both young and adult consumers.

Sample	Appearance	Taste	Aroma	Overall acceptability
HBA	4.25 ± 0.35^{c}	5.35 ± 0.39^{b}	5.80 ± 0.41^{b}	5.55 ± 0.43^{b}
GCB	5.20 ± 0.30^{b}	5.95 ± 0.27^{b}	5.80 ± 0.28^{b}	5.90 ± 0.28^{b}
FDC	5.45 ± 0.37^{b}	6.00 ± 0.35^{b}	5.90 ± 0.37^{b}	6.15 ± 0.37^{b}
EED	4.80 ± 0.34^{bc}	5.35 ± 0.42^{b}	5.10 ± 0.38^{b}	5.35 ± 0.33^{b}
CON	8.25 ± 0.18^{a}	7.75 ± 0.32^{a}	7.80 ± 0.22^{a}	8.10 ± 0.18^{a}

Table 6: Sensory Evaluation of the Noodles Produced.

Values are means of three replicates ± standard deviation. Mean values followed by different superscripts within columns are significantly different by Duncan's multiple range tests ($p < 0.05$).

Keys: HBA-80-20% Flour Formulations of Noodles Produced**,** GCB - 70-30% Flour Formulations of Noodles Produced**,** FDC-60-40% Flour Formulations of Noodles Produced**,** EED-50 -50% Flour Formulations of Noodles Produced**,** CON-Commercial Noodles.

Bibliography

1. Abe-Inge V., *et al*. "Development and evaluation of African palmyra palm (Borassus aethiopum) fruit flour-wheat composite flour noodles". *Cogent Food and Agriculture* 6.1 (2020): 1749216.
2. Adebowale OJ., *et al*. "Quality characteristics of noodles produced from wheat flour and modified starch of African breadfruit (*Artocarpus altilis*) blends". *Journal of Culinary Science and Technology* 15.1 (2017): 75-88.
3. Adegbanke OR., *et al*. "Application of Bambara groundnut in the production of cookies". *Food Science and Quality Management* 83 (2019): 56-60.
4. AOAC. "Official methods of analysis". 15th Edition. Washington DC: Association of Official Analytical Chemists (2005).
5. AOAC. "Official methods of analysis of AOAC International. Volume I, agricultural chemicals, contaminants, drugs/edited by William Horwitz (2010).
6. AOAC. "Official Methods of Analysis". 21st Edition. Association of Official Analytical Chemists, Washington D.C, USA (2019).
7. Aremu MO., *et al*. "Biochemical evaluation of fermented white maize (*Zea Mays* L.) blended with Scarlet Runner Bean (*Phaseolus coccineus* L.) Flour". *The Open Nutraceuticals Journal* 4.1 (2017).
8. Chepkosgei TM and Orina I. "Quality and sensory properties of instant fried noodles made with soybean and carrot pomace flour". *African Journal of Food Science* 15.3 (2021): 92-99.
9. Egbuna C., *et al*. "Blood Glucose Level and Serum Lipid Profile Of Wistar Albino Rats Fed Four Species Of Local Beans Consumed In South-East, Nigeria". *European Journal of Biomedical and Pharmaceutical Sciences* 7.5 (2020): 30-39.
10. Fu BX. "Asian noodles: History, classification, raw materials, and processing". *Food Research International* 41.9 (2008): 888-902.
11. Kanchana R., *et al*. "Sensory evaluation of nutritionally potential high protein low glycemic index noodles". *Journal of Scientific Research* 64.2 (2020).
12. Mahmoud EA., *et al*. "Production of high protein quality noodles using wheat flour fortified with different protein products from lupine". *Annals of Agricultural Sciences* 57.2 (2012): 105-112.
13. Noah AA and Adedeji MA. "Quality assessment of cookies produced from wheat and red kidney bean flour". *International Journal of Food and Nutritional Sciences* (2020): 1-4.
14. Okafor GI and Usman GO. "Production and Evaluation of Breakfast Cereals from Blends of African Yam Bean (*Sphenostylis stenocarpa*), Maize (*Zea mays*) and Defatted Coconut (*Cocus nucifera*)". *Journal of Food Processing and Preservation* 38.3 (2014): 1037-1043.

15. Pakhare KN., *et al*. "Enhancement of nutritional and functional characteristics of noodles by fortification with protein and fiber: a review". *Journal of Pharmacognosy and Phytochemistry* 7.1 (2018): 351-357.

16. Rani S., *et al*. "Optimization and evaluation of multigrain gluten-enriched instant noodles". *Applied Biological Chemistry* 61.5 (2018): 531-541.

17. Sharma D., *et al*. "Nutrient analysis of raw and processed soybean and development of value-added soybean noodles". *Inventi Rapid: Lifestyle* 1 (2014): 1-5.

18. Yadav BS., *et al*. "Studies on suitability of wheat flour blends with sweet potato, colocasia and water chestnut flours for noodle making". *LWT-Food Science and Technology* 57.1 (20144): 352-358.