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Microbial, Nutrient Composition and Sensory Qualities of Cookies Fortified with Red Kidney Beans (*Phaseolus vulgaris L.*) and Moringa Seeds (*Moringa oleifera*)

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Abstract: The microbial, nutrient and sensory qualities of cookies produced from wheat flour supplemented with red kidney bean and moringa seed flours, formulated as 100:0:0%, 90:5:5%, 80:10:10%, 70:15:15%, and 60:20:20% were studied. Microbial analysis shows total viable count range from 1.5 to 3.5 x 10^2cfu/g, Fungi counts ranges from 1.0 to 1.4 x 10^2cfu/g while there was no growth of *Staphylococcus* and *Salmonella*. The microbes increase slightly with increase in the substitution of red kidney bean and moringa seeds flour although all the counts were minimal and are within acceptable limits 10^6cfu/g of ready to eat food product. The moisture, protein, ash, fibre, fat and carbohydrate contents in the cookies ranges from 6.21 to 4.67%, 9.46 to 15.99%, 1.16 to 2.68%, 0.32 to 2.48%, 17.02 to 13.88% and 65.81 to 59.99% respectively. The cookies sample increases in protein, ash, fibre and mineral contents with increasingly added red kidney bean and moringa seed flours. Sensory evaluation depict that cookies sample are significantly different in attributes. Cookies produced from blends of 70:15:15% are observed to be more acceptable of all samples. Result from the work carried out reveals that acceptable cookies of improved nutritional value, high dietary fibre and protein content can be produced from wheat flour supplemented with red kidney bean and moringa seed flours.

Keywords: Cookies, Wheat Flour, Red Kidney Bean Flour, Moringa Seed Flour, Microbial, Quality

1. Introduction

Cookies are conventionally wheat flour-based food product that has become a major component of human snacks in most part of the world. Cookies are nutritive snacks produced from unleavened dough that is transformed into appetizing product through the application of heat in an oven [1] Cookies are common examples of bakery product of ready-to-eat snack that possess several attractive features including wide consumption, more convenient with long shelf-life and have the ability to serve as vehicles for important nutrient [2]. Cookies are one of the best known quick snack products [3]. Cookies and other bakery products have now become preferred fast food products for every age-group, because they are easy to carry about, tasty to eat, cholesterol-free containing digestive and dietary principles of vital importance and reasonably cheap [3]. They differ from other bakery foods like bread and cakes because they have low moisture content, making them comparatively free from microbial spoilage and having long shelf-life [4]. The main ingredients of cookies are wheat flour, fat (margarine), sugar and water, while other ingredients such as milk, salt, aerating agent, emulsifier, flavor, and color are added by choice. They can also be enriched or fortified with other ingredients in order to meet specific nutritional or therapeutic needs of consumers [2]. Wheat flour constitutes the basic ingredient for cookies production because of its gluten proteins, which are not present in flours of other cereals. Gluten protein forms elastic dough during baking and gives high organoleptic quality to the finished products [5].

Wheat is the most widely produced cereal in the world, most of which is destined for human consumption; thus its contribution to energy intake is significant. Wheat flour is a powder made from milling of wheat grain. Wheat flour (also hard flour) has high gluten content between 12% to 14% and its dough has elastic toughness that holds its shape well once baked [6]. Wheat is a very important cereal for daily intake of protein, vitamins, minerals and fibres in a growing part of the world population [7]. It is the leading source of vegetal protein in human food, having a protein content of about 13% which is relatively high compared to other major cereals but relatively low in protein quality for supplying essential amino acids [8]. When eaten as the whole grain, wheat is a source of multiple nutrients and dietary fibre [9].

Red kidney beans (*Phaseolus vulgaris L.*), a grain legume, is one of the tropical legumes that can be used to improve the diets of millions of people who cannot afford expensive animal protein because of its high protein content [10, 11]. It is also a rich source of vitamins, minerals and crude fibre but is relatively low in fat [12]. Its protein has highest lysine content about 5% [13]. Red kidney beans have extraordinary health benefits due to high quantities of folic acid, calcium, carbohydrates, fibre and proteins amongst the proper functioning of the body. In spite of its high nutritional and health benefits, raw red kidney beans contain large amount of anti-nutritional factors including phytic acid, hemagglutinins, trypsin inhibitors, tanins and saponins which can affect the absorption of protein and certain minerals [14]. Traditional processing methods such as soaking, boiling, germination and fermentation have proven to be effective in reducing or eliminating anti-nutritional factors present in legumes [15, 16].

Moringa oleifera is one of the most recently cultivated plants in West African regions. The plant is entirely edible from leaves to roots. *Moringa* seeds contain significant sources of minerals (calcium, phosphorus, and iron) and vitamins (A, B and C). It is rich in protein but low in fat and carbohydrates [17, 18]. It is not only rich in nutritional content but also has some medicinal properties [17]. The use of *moringa* leave powder for food fortification has been reported by many studies [19, 20]. However, the protein, fat and mineral content of *moringa* seed has been reported to be significantly higher than that of *moringa* leave [21].

Wheat has a protein content of about 13% which is relatively high compared to other major cereals but relatively low in protein quality for supplying essential amino acids [8]. Blending of cereal flour with legume flour such as red kidney bean flour with high protein content would help improve the nutritional value of the product and could be used to alleviate the problem of protein energy malnutrition still prevalent in our communities. *Moringa* seed is rich in protein and mineral. *Moringa* seed is not only rich in nutritional content but also has a preservative effect. Thus, fortification of wheat flour with red kidney bean flour and *moringa* seed flour could therefore significantly improve the nutritional quality of the composite flour. The aim of the present study was to evaluate the nutrient composition, microbial and sensory qualities of cookies fortified with red kidney bean and *moringa* seed flours.

2. Materials and Methods

2.1. Sample Procurement

Matured red kidney bean seeds were purchased from IITA, Ibadan. The *moringa* seeds were obtained from Ifo, Ogun State. Wheat flour and other baking ingredients (sugar, fat, salt, baking powder, eggs and flavouring) were purchased in *Sayedero* market in Ilaro, Ogun State, Nigeria while all reagents used were of analytical grade.

2.2. Preparation of Materials

2.2.1. Preparation of Red Kidney Bean Flour

The kidney bean flour was prepared using the method described by [22]. A portion of the beans was taken and soaked in boiled distilled water at 95°C in the ratio of 1:5 w/v for ½ hour in beaker. After half an hour, the water was decanted and the beans later washed with fresh water. The beans was soaked overnight at room temperature. The soaked water was drained on the following day, beans de-hulled manually and dried in the oven at 65°C for 6 hours so as to make them moisture free. The dried beans was milled into powdered form and stored in air-tight containers for production and analysis.

2.2.2. Preparation of Moringa Seed Flour

The *moringa* seed flour was prepared in accordance to the method described by [23]. *Moringa* seeds were manually removed from the seed kernels and dried using cabinet drier (60°C for 5 days). The dried seeds were milled in a clean blender. The *moringa* seed powder was then sieved using a sieve of 500 µm mesh size, to obtain a fine powder.

2.2.3. Formulation of Composite Flours

Composite flours with different proportions of wheat, red kidney bean and *moringa* seed flour was prepared as shown in Table 1 with 100% wheat flour serving as control. A Kenwood Food Processor (Model A 907, D, Kenwood Ltd, England) was used for weighing and mixing the flours respectively.

Table 1. *Formulation of wheat-red kidney-moringa dough for cookie production.*

Sample codes (%)	Wheat flour (%)	Red kidney bean flour (%)	Moringa seed flour (g)	Fat (g)	Sugar (g)	Egg (g)	Salt
A (control)	100	0	0	45	55	30	0.6
B	90	5	5	45	55	30	0.6
C	80	10	10	45	55	30	0.6
D	70	15	15	45	55	30	0.6
E	60	20	20	45	55	30	0.6

2.2.4. Preparation of Cookies

The cookies were prepared according to the method of Okpala *et al*. [24]. The flour was prepared by homogenous mixing of wheat flour with red kidney beans flour and *moringa* seeds flour in the percentage proportion 100 0 0, 90 5 5, 80 10 10, 70 15:15, 60:20:20 The preparation of the cookies contained 55 g sugar, 45 g fat, 0.6 g salt, and 30 g beaten egg. During the preparation, sugar, flour and salt were hand mixed in a plastic bowel while fat was added later, the mixture was mixed further by hand until a bread crumb-like mixture was obtained. The beaten egg was added and the mixture was mixed thoroughly to obtain the dough. The dough was rolled manually on a flat and smooth floured board into sheets of uniform thickness of 5 mm and cut with a cookie cutter with diameter of 3 mm. The cut dough were transferred into baking trays lined with grease-proof paper and baked at 180°C for 20 minutes in a domestic oven. Thereafter, the cookies were cooled at room temperature (30±2°C). The cookies were allowed to cool and placed in a plastic plate package. Similarly, cookies made with 100% wheat flour were prepared in the same way as earlier described and used as control. The product was evaluated organoleptically with proximate, mineral and microbial analysis carried out respectively.

2.3. Methods of Analysis

2.3.1. Microbial Analysis

Ten (10) grams of each cookies samples was diluted in 90 ml of sterile distilled water in a conical flask to get the aliquot, a tenfold serial dilution was carried out. An aliquot of 1 ml from selected dilutions of each sample was inoculated aseptically into labelled triplicate agar plates of the media (Nutrient Agar for total viable count, Baidparker agar for *Staphylococcus* count, Bismuth sulphite agar for *Salmonella* count) using standard pour plate method and incubated at 37°C ±2°C for 24 to 48 hours. Potato Dextrose Agar was incubated at (28°C±2°C) for 3 to 5 days for isolation of fungi. Colonies were enumerated at the end of incubation period using digital colony counter (Gallenkamp England) [25].

2.3.2. Determination of Nutrient Composition of Cookies

Protein, fat, ash, fibre and moisture were determined following the procedure outlined by AOAC [26] while the carbohydrate content was calculated by difference. Mineral content (Ca, Mg, Fe, Cu and Mo) were determined using Atomic Absorption Spectrophotometer (UNICAM Model 939, UK) as described in AOAC [27].

2.3.3. Sensory Evaluation

Coded samples of cookies were presented to ten (10) panelists. All panelists were regular consumers of cookies and were familiar with sensory quality attributes of cookies. They were instructed to score the following attributes: colour, texture, taste, flavour and overall acceptability of the products using 9-point hedonic scale ranging from 1 (dislike extremely) to 9 (liked extremely) [28]. Questionnaire for entering scores and potable water for mouth rinsing between tasting were made available to the panelists. The 100% wheat flour cookie was used as control.

2.4. Statistical Analysis

Means of duplicate data were subjected to a one-way analysis of variance (ANOVA) using SPSS statistical package version 20.0 (SPSS Inc, Chicago, USA) to determine significant differences between the quality attributes of samples with Duncan's Multiple Range Test (DMRT) at $p<0.05$.

3. Results and Discussion

3.1. Microbial Analysis of the Fortified Cookies

Microbial analysis The results obtained from the microbial quality investigated are shown in Table 1. The results obtained for total aerobic counts and fungi counts were low in all the cookie samples. The total viable counts range from 1.5 to 3.5 $x10^2$cfu/g. Sample A had the lowest count while Sample E ((60% Wheat flour: 20% Red kidney bean flour: 20% *Moringa* seed flour) had the highest microbial counts of $3.5x10^2$cfu/g. this is due to the fact that increase in protein content of the samples encourage the microbial action and this is caused by incorporation of Red kidney bean flour. Fungi count ranges from 1.0 to $1.4x10^2$cfu/g There were no *Staphylococcus* and *Salmonella* growth contaminations in all the samples. The absence of these pathogens shows that the cookies produced is acceptable and it reflects high hygiene standards adopted in the food preparation. This study has shown the total viable count of the cookies are within the microbial limit of 10^4 to less than 10^6cfu/g of ready to eat food product [29].

Table 2. *Microbial Analysis of cookies made from wheat flour fortified with red kidney bean and moringa seed flours.*

Samples	Total viable count cfu/g	Fungi count cfu/g	*Staphylococcus* count cfu/g	*Salmonella* count cfu/g
A	$1.5 x10^2$	$1.0 x 10^2$	Nil	Nil
B	1.7×10^2	1.0×10^2	Nil	Nil
C	2.0×10^2	1.4×10^2	Nil	Nil
D	3.2×10^2	1.5×10^2	Nil	Nil
E	3.5×10^2	1.4×10^2	Nil	Nil

A (100% Wheat flour); B (90% Wheat flour: 5% Red kidney bean flour: 5% *Moringa* seed flour); C (80% Wheat flour: 10% Red kidney bean flour: 10% *Moringa* seed flour); D (70% Wheat flour: 15% Red kidney beans flour: 15% *Moringa* seed flour); E (60% Wheat flour: 20% Red kidney bean flour: 20% *Moringa* seed flour).

3.2. Proximate Composition of the Fortified Cookies

The proximate composition of fortified cookies is presented in Table 3. The result shows that protein, fibre and ash contents increases as the proportion of red kidney beans flour and *moringa* seeds flour increases from 9.46 to 15.99%, 0.32 to 2.48%, and 1.16 to 2.68% respectively while moisture, fat and carbohydrate contents drops, ranging from 6.21 to 4.67%, 17.02 to 13.88% and 65.81 to 59.99% respectively. The highest moisture, fat and carbohydrate contents was recorded in sample with 100% wheat flour while the highest value for protein, ash and fibre was recorded in 60% wheat flour, 20% red kidney bean flour and 20% *moringa* seed flour. The high protein and fibre content in cookies produced from the composite flour would be of nutritional importance in most developing countries like Nigeria where people can hardly afford high proteinous foods because of high cost.

Table 3. *Proximate composition (%) of cookies made from wheat flour fortified with red kidney bean and moringa seed flours.*

Sample codes (%)	Moisture (%)	Protein (%)	Ash (%)	Fat (%)	Fibre (%)	Carbohydrate
A	$6.21^{e}\pm0.02$	$9.46^{a}\pm0.01$	$1.16^{a}\pm0.01$	$17.02^{e}\pm0.01$	$0.32^{a}\pm0.01$	$65.81^{e}\pm0.01$
B	$5.91^{d}\pm0.01$	$9.91^{b}\pm0.01$	$1.73^{b}\pm0.01$	$16.89^{d}\pm0.01$	$0.52^{b}\pm0.01$	$64.99^{d}\pm0.00$
C	$5.45^{c}\pm0.03$	$11.36^{c}\pm0.01$	$1.96^{c}\pm0.03$	$15.95^{c}\pm0.01$	$0.86^{c}\pm0.01$	$63.89^{c}\pm0.01$
D	$4.93^{b}\pm0.01$	$13.96^{d}\pm0.01$	$2.36^{d}\pm0.01$	$14.97^{b}\pm0.02$	$1.89^{d}\pm0.01$	$61.88^{b}\pm0.03$
E	$4.67^{a}\pm0.03$	$15.99^{e}\pm0.01$	$2.68^{e}\pm0.01$	$13.88^{a}\pm0.01$	$2.48^{e}\pm0.01$	$59.99^{a}\pm0.01$

Values are means of duplicate determination ± SD (Standard deviation). Means in the same column with different superscript are significantly different ($p<0.05$). A (100% Wheat flour); B (90% Wheat flour: 5% Red kidney bean flour: 5% *Moringa* seed flour); C (80% Wheat flour: 10% Red kidney bean flour: 10% *Moringa* seed flour); D (70% Wheat flour: 15% Red kidney beans flour: 15% *Moringa* seed flour); E (60% Wheat flour: 20% Red kidney bean flour: 20% *Moringa* seed flour).

Moisture content in the cookies ranged from 6.21-4.67%, which could be attributed to adequate drying of the red kidney beans and *moringa* seeds with significant difference ($p<0.05$) across the samples. The result shows that red kidney beans and *moringa* seeds have low moisture content. However, the fortified cookies would have longer shelf life than the un-fortified cookies due to its relatively low moisture content.

The protein content in the cookies ranged from 9.46-15.99% which could be due to high protein content in red kidney beans flour and *moringa* seeds flour. This result shows there was significant difference ($p<0.05$) across the cookie samples. It was reported that biscuits fortified with red kidney bean flours have increased protein content (12.05-15.20%) attributed to the higher amount of protein content in red kidney beans flour relative to the other flours [30]. Red kidney beans have been reported to contain 25.78% protein by [31] while *moringa* seed flour contains 28% by [32]. The protein content of fortified cookies reported in this study is higher than that of biscuits fortified with red kidney beans flour, this could be due to the incorporation of red kidney bean and *moringa* seed flours. The result suggests that cookies made from these flour blends may be useful as food supplement for the alleviation of protein malnutrition in vulnerable group.

The ash content in the cookies ranged from 1.16-2.68%. The increment of ash content in the fortified cookies could probably be due to the higher ash content (4.1%) of *moringa* seed flour as reported by Abiodun *et a l* [32]. and 4.4% of red kidney beans flour as estimated by [33]. The data shows that there was significant difference ($p<0.05$) between the cookie samples. Sample E had the highest value (2.68%) while control sample (100%) has the lowest value (1.16%). The ash content (1.16-2.68%) obtained in this study is in line with the ash content (2.86%) of cookies made from cassava, soybean and mango composite flours, [33] and the ash content (1.69%) of biscuits fortified with red kidney bean flour [30]. The ash content of a food sample is an index of the mineral element of such food. The result obtained gave an indication that the cookies produced from the composite flour are good source for minerals.

The fibre content in the cookies ranged from 0.32-2.48%. The fibre content increased significantly ($p<0.05$) due to the fortification of wheat flour with red kidney beans flour and *moringa* seed flour in the cookies formulation. Sample A (control) had the lowest value (0.32%) while sample E had the highest value (2.48%). There was significance difference ($p<0.05$) across the cookie samples. The higher fibre content observed in the fortified cookies is in agreement with crude fibre content (1.30 to 2.05%; 1.69%) obtained for cookies produced from composite flour of cassava, soybean and mango [33] and biscuits produced from wheat flour, acha and red kidney bean flour [30]. Dietary fibre has been shown to have a great impact on health of consumers. The presence of high dietary fibre in food products is essential owing to its ability to facilitate bowel movement and prevention of constipation thereby contributing to the health of gastro-intestinal and metabolic system in man [34].

The fat content of the fortified cookies ranged from 17.02 to 13.88% with the control sample (100%) having the highest fat content (17.02%). The data shows that there was significant difference ($p<0.05$) between the cookie samples. The fat content of the fortified cookies reported in this study is higher than that of cookies (5.76-8.40%) produced from cassava, soybean and mango composite flours [33] and fat content (1.95%) of biscuits fortified with red kidney bean flour. The low fat content could be attributed to the relatively low fat content of red kidney bean and *moringa* seed flours. Fat is a rich source of energy and also serves as carriers of fat soluble vitamins A, D, E and K [35]. However, high level of fat in food products could lead to rancidity and development of unpleasant flavour.

The carbohydrate content in the cookies ranged from 65.51-59.99% which decreased as the substitution of red kidney beans and *moringa* seed flour increased in the blend. There was significant difference (p<0.05) across the cookie samples. Sample A (control) had the highest carbohydrate content (65.8%) while cookies made from 20% red kidney beans and moringa seed flours respectively had the least carbohydrate content (59.99%). This observation is in line with other study that also reported low level of carbohydrate content of cookies from cassava, soybean and mango composite flours. Such decrease in carbohydrate content of cookies with increasing substitution of soybean flour has been reported [34].

3.3. Mineral Composition of the Fortified Cookies

The mineral content of the prepared cookies is presented in Table 4. The result shows that calcium, magnesium, iron and molybdenum increased significantly (p<0.05) ranging from 8.01-11.16 mg/l, 0.52-4.68 mg/l, 2.38-5.33 mg/l and 0.02-0.18 mg/l respectively due to the fortification of wheat flour with red kidney beans flour and *moringa* seed flour while copper decreased (0.03-0.003 mg/l) as the incorporation of the flours increased. *Moringa* seed flour and red kidney beans flour has been reported to be rich in minerals that are essential for human development and growth [23, 36].

Table 4. *Mineral composition (mg/l) of cookies made from wheat flour fortified with red kidney bean and moringa seed flours.*

Sample	Calcium (mg/l)	Magnesium (mg/l)	Iron (mg/l)	Copper (mg/l)	Molybdenum
A	$8.01^{a}\pm0.01$	$0.52^{a}\pm0.00$	$2.38^{a}\pm0.01$	$0.03^{d}\pm0.0$	$0.02^{a}\pm0.01$
B	$8.57^{b}\pm0.01$	$1.01^{b}\pm0.01$	$3.41^{b}\pm0.15$	$0.02^{c}\pm0.00$	$0.07^{b}\pm0.01$
C	$8.89^{c}\pm0.01$	$1.57^{c}\pm0.01$	$4.87^{c}\pm0.01$	$0.004^{b}\pm0.00$	$0.09^{b}\pm0.01$
D	$9.89^{d}\pm0.01$	$3.66^{d}\pm0.01$	$5.17^{d}\pm0.01$	$0.015^{a}\pm0.00$	$0.15^{c}\pm0.01$
E	$11.16^{e}\pm0.01$	$4.68^{e}\pm0.01$	$5.33^{d}\pm0.01$	$0.003^{ab}\pm0.00$	$0.18^{d}\pm0.01$

Values are means of duplicate determination ± SD (Standard deviation). Means in the same column with different superscript are significantly different (p<0.05). A (100% Wheat flour); B (90% Wheat flour: 5% Red kidney bean flour: 5% *Moringa* seed flour); C (80% Wheat flour: 10% Red kidney bean flour: 10% *Moringa* seed flour); D (70% Wheat flour: 15% Red kidney beans flour: 15% *Moringa* seed flour); E (60% Wheat flour: 20% Red kidney bean flour: 20% *Moringa* seed flour).

The calcium content of *moringa* seed flour is more than two times that of milk reported by [21]. The high calcium content (8.01-11.16 mg/l) of prepared cookies reported in this study could be as a result of high calcium in red kidney beans flour and *moringa* seed flour to wheat flour. There was significant difference (p<0.05) across the cookies samples as shown in the table. The calcium present makes bones stronger and prevents osteoporosis [36]. It plays an important role in blood clotting, muscle contraction and in certain enzymes in metabolic process [37].

The magnesium content (0.52-4.68 mg/l) of the fortified cookies increase significantly (p<0.05) which could be due to high magnesium content in red kidney bean and *moringa* seed flours. Un-fortified cookies (control sample) has the lowest magnesium content (0.52 mg/l) while cookies made from 20% red kidney beans and *moringa* seed flour respectively had the highest magnesium content (4.68 mg/l) with significant difference (p<0.05) between the cookie samples. Magnesium is important for maintaining normal nerve and muscle function, supports a healthy immune system and helps to regulate blood glucose levels and aid in the production of energy and protein [30].

The iron content ranged from 2.38 to 5.33 mg/l with the control sample (100%) having the least iron content (2.38 mg/l). There was significant difference (p<0.05) across the cookie samples. The high iron content obtained in this study is in agreement with the estimated iron content (5.12 mg/l) of biscuits produced from wheat flour, acha and red kidney bean flour by [28]. Red kidney beans has been reported to be a good source of iron [36]. Olushola [18] reported that *moringa* seed also contains significant amount of iron. Iron is an important component of heamoglobin, the substance in red blood cells that carries oxygen from the lungs to transport it throughout the body [38]. Adequate iron in the diet is essential to minimize the incidence of iron deficiency anemia which is considered as the most common nutritional disorder worldwide [39].

The copper content ranged from 0.03 to 0.003 mg/l with control sample (100%) having the highest copper content. There was significant difference (p<0.05) between the cookie samples. The decrease in the copper content across the cookie samples could be due to the low copper content in red kidney bean and *moringa* seed flours. Copper together with iron enables the body to form red blood cells. It helps to maintain healthy bones, blood vessels, nerves and immune function and contributes to iron absorption in the body [30].

The molybdenum content in the cookies ranged from 0.02-0.18 mg/l significantly (p<0.05) across the samples. Sample A (control) had the least molybdenum content (0.02 mg/l) while sample E had the highest value (0.18 mg/l). There was significant difference (p<0.05) between the samples. The increase in the cookie samples could be attributed to its high concentration in red kidney bean flour (the most abundant mineral). Molybdenum is an essential nutrient responsible for the removal of toxins from the metabolism of sulphur-containing amino acids [34].

3.4. Sensory Evaluation of the Fortified Cookies

The result of the sensory evaluation of the fortified cookies is presented in Table 5. The result shows that the mean scores by the panelists for colour, texture, taste, flavour and overall acceptability varied among the samples (A, B, C, D and E). Colour and taste are important sensory characteristics that affect the acceptability of any food product by the consumers; [28].

Table 5. *Sensory scores of cookies made from wheat flour fortified with red kidney bean and moringa seed flours.*

Sample	Colour	Texture	Taste	Flavour	Overall acceptability
A	$7.80^{a}\pm0.92$	$7.50^{ab}\pm1.08$	$7.70^{a}\pm1.25$	$7.20^{ab}\pm0.92$	$7.50^{ab}\pm0.97$
B	$7.50^{a}\pm1.18$	$7.60^{b}\pm0.97$	$7.00^{a}\pm0.94$	$6.60^{a}\pm1.07$	$7.90^{b}\pm0.74$
C	$7.60^{a}\pm0.97$	$7.40^{ab}\pm0.84$	$6.80^{a}\pm1.55$	$6.90^{ab}\pm1.20$	$7.30^{ab}\pm1.06$
D	$7.80^{a}\pm0.79$	$7.90^{b}\pm0.88$	$7.60^{a}\pm1.07$	$7.60^{b}\pm0.84$	$8.00^{b}\pm0.82$
E	$7.10^{a}\pm0.74$	$6.70^{a}\pm0.67$	$7.00^{a}\pm0.82$	$6.50^{a}\pm0.53$	$6.80^{a}\pm0.63$

Values are means of duplicate determination ± SD (Standard deviation). Means in the same column with different superscript are significantly different ($p<0.05$). A (100% Wheat flour); B (90% Wheat flour: 5% Red kidney bean flour: 5% *Moringa* seed flour); C (80% Wheat flour: 10% Red kidney bean flour: 10% *Moringa* seed flour); D (70% Wheat flour: 15% Red kidney beans flour: 15% *Moringa* seed flour); E (60% Wheat flour: 20% Red kidney bean flour: 20% *Moringa* seed flour).

Colour showed no significant difference ($p>0.05$) across the cookie samples which ranged from 7.10 to 7.80. Sample A and D had the highest mean scores of 7.80 while the lowest value was observed in sample B. Texture ranged from 6.70 to 7.90 with significant difference ($p<0.05$) across the samples. Sample E was the least preferred as the mean score value (6.70) was significantly lower than the rest of the samples while sample D had the highest mean score (7.90). This could be that the texture of the product was affected at the level of substitution of flours incorporation used. Taste showed no significant difference ($p>0.05$) across the samples, it ranges from 6.80 to 7.70. Sample A had the highest mean scores (7.70) while sample C had the lowest value (6.80). Flavour ranges from 6.50 to 7.60 with significant difference ($p<0.05$) among the cookies sample. Sample D has the highest mean score (7.60) while sample E has the least value (6.50). In terms of overall acceptability, it ranges from 6.80 to 8.00 showing significant difference ($p<0.05$) across the cookies sample. However, sample D with the highest mean score (8.00) was the most preferred sample while sample E was the least preferred sample having mean score of 6.80. However, the substitution of wheat flour with red kidney bean and *moringa* seed flours at a level up to 15% respectively produced good and appreciable results.

4. Conclusion

The study shows the high nutritional value of Red kidney beans flour and *Moringa* seeds flour in terms of their protein and fibre composition, this is relatively high, can serve as supplements with wheat flour in the production of cookies and other baked food products. Cookies with high nutritional content can be produced from different combination of composite flours to alleviate the problem of malnutrition due to low protein intake. It has also been able to bring forth another utilization of red kidney beans which can be used to produce an internationally acceptable product like cookies.

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