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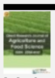

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**Research Article**
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# Quality Evaluation, Mineral Composition and Vitamin Content of "*Ndaleyi*" (Millet Stiff Forage) Produced from Pearl Millet (*Pennisetum Glaucum*) and Bambara-nut Flour Blends


**Fatima Abubakar[1], and Aminu Barde[2*]**

[1]Lake Chad Research Institute, P.M.B 1293, Maiduguri, Borno State, Nigeria.
[2]Department of Food Science and Technology, Aliko Dangote University of Science and Technology Wudil, P. M. B. 3244, Kano, Nigeria.
*Corresponding author email: aminubarde@yahoo.com



**ABSTRACT**

*"Ndaleyi" is a fermented sundried agglomerated powder produced from pearl millet which is widely consumed across all ages of the royal families in the north western Nigeria, mostly by the Kanuri people of Borno State. It is prepared from reconstitution of starch flour with cold water to form slurry and added to the boiling water containing groundnut oil (to avoid sticking) with continuous stirring to form a thick gruel. The study focus on production, proximate, functional, minerals, vitamins and acceptability of ndaleyi produced by substituting millet flour with bambaranut flour, were evaluated at different proportions (10, 20, 30, 40 and 50 of bambaranut flour). ndaleyi prepared with 100% of millet flour served as control. Results showed that "ndaleyi" (millet stiff forage) had significantly increased in ash, protein, fat, crude fibre with decreased in carbohydrate than the control M (100% millet). Variation in functional properties of the flour, sample $MBN_2$ had higher amount of iron (11.29mg/100g), potassium (466.90mg/100g), and magnesium (316.67mg/100g). Vitamin c significantly decreased with increased in riboflavin resulting from substitution with bambaranut flour. Sample $MBN_2$ was overall accepted when compared with the control followed by samples $MBN_1$ and $MBN_3$ This also showed that all the formulations shows a significant difference based on the sensory attributes such as thickness, colour, flavor, texture and overall acceptability.*



***Keywords:*** *Ndaleyi, proximate, mineral, vitamin*

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## INTRODUCTION

Cereal grain in the form of rice, wheat, millet constitutes the majority of daily calories in developing countries, Cereal consumption varied substantial; primarily in the form of refined and processed grains (Mundell 2019).Millet is a collective term referring to a number of small seeded annual grasses that are cultivated as grain crops in developing countries mainly Asia and Africa account for about 94% of global output estimated at 28 million tonnes FAO, (2013). The most important millets are Pearl millet (*Pennisetum glaucum*), Finger millet (*Eleucine coraccana*), Proso millet (*Panicum miliaceum*) and Foxtail millet (*Setaria italica*). Legumes such as bambaranut is a rich and less expensive sources of dietary proteins and water-soluble vitamins.

The substitution of cereal grain with bambaranut in foods will enhance the utilization of local crops as raw materials and improve the nutritive quality of the products. "Ndaleyi" is a fermented sundried agglomerated powder produced from pearl millet which is widely consumed across all ages of the royal families in the north western Nigeria, mostly by the Kanuri people of Borno State (Nkama et al., 2000). It is prepared from reconstitution of starch flour with cold water to form slurry and added to the boiling water containing groundnut oil (to avoid sticking) with continuous stirring to form a thick gruel. An expensive food product, thence it is called royal food and also eaten during festive period like Sallah, Naming and Wedding Ceremonies. Ndaleyi as cereal based food which is mainly starch and it has a low nutritional value, according to (Makumba *et al*., 2016) a combination of cereals with legumes would improve the protein and nutrient density of the subsequent food products. Therefore, there is the need to produce "Ndaleyi" from the blend of pearl millet and bambaranut flour. The objectives of this study were to determine the characteristics of "Ndaleyi" at various proportions of millt and bambaranut flour.

## MATERIALS AND METHODS

### Materials

The raw materials used for this research were Pearl millet (pennisetum glaucum) and Bambaranut purchased from (KNARDA) kano Agricultural and Rural Development Authority. The chemical and reagents used were of analytical grade and obtained from Department of Food Science and Technology laboratory, Aliko Dangote University of Science and Technology, Wudil Kano State.

### Method of preparation of *Ndaleyi* flour

The preparation of millet for *Ndaleyi* flour production involves cleaning the millet seed using manual sorter to remove any foreign matter and contaminants. The grains were then steeped in large quantity of clean tap water at ambient temperature of about 37°C for 2 days in a plastic bowl. The steeping water was decanted and the grains were washed with fresh water and then wet milled using a grinding machine. The resulting paste was sieved using a fine cheese cloth and additional water was added to the paste during sieving to completely remove the chaff from the slurry. After sieving the filtrate was transferred into a special traditional clay pot and then stirred vigorously to aid in settling (Figure 1). That was covered and allowed stand overnight to separate by differential settings into 3 layers. The top layer is the water for the filterate, the middle layer is the *chir* which is the protein fraction of the grain, while the last layer was the starch. The water was decanted while both the *chir* and *Ndaleyi* are carefully separated and sundried at 31°C for 48hours. The dried products were pulverized, sieved using 1.19mm sieved mesh to obtained soft flour and packaged in air tight containers for use (Figure 1).

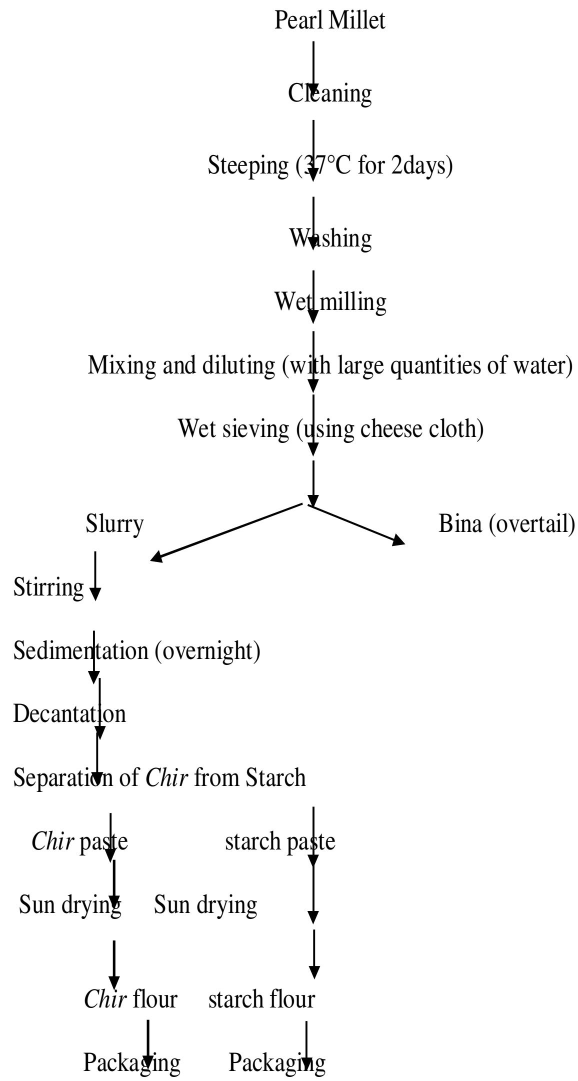


**Figure 1:** Processing flow chart of the millet grain for the production of *Ndaleyi*: Source: local producers.

### Method for bambaranut flour preparation

The dried seeds were dehulled to remove the skin, using a manual Corona Laders Y CIA A.8 extruder while the seeds were manually separated, from the hulls. The seeds with skin were placed on baking trays and were continuously hurled in the air, separating the hulls from the seed and, once separated, hulls. The seeds were then ground to flour with sieve size 250 µm using a Trapp Animal Ration Shredder Hammer Mill Foliage TRF 400.

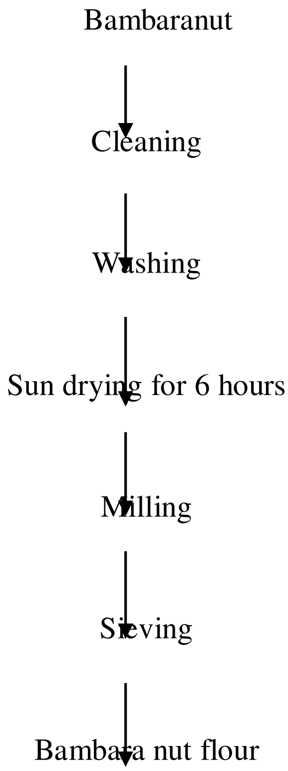


**Figure 2:** Production of Bambara nut flour. Source; local producers.

The final Bambara groundnut flour was placed into zip lock bags and stored at refrigeration temperature (4-6°C) for used (Figure 2).

## Preparation of *Ndaleyi* (millet stiff forage)

The grain processing steps for the production of *Ndaleyi* was similar to the production of Ogi as reported by (Ome and Michael 2015) but with slight modification. That involves the addition of groundnut oil to the boiling water. The starch flour for the *Ndaleyi* was reconstituted with cold at room temperature to make slurry. The slurry was then added to the boiling water and stirred continuously without stopping until cooked to a thick gruel for 20 minutes. The *Ndaleyi* (millet stiff forage) was ready for serving, either with stew or soup. The samples of ndaleyi used for analysis were collected, dried, crushed to reduce the size and then packed for further analysis.

## Formulation of *Ndaleyi* (millet stiff forage) composite flours

A total of six (6) samples were obtained with five of the samples were bended with Bambara nut flour and each having various ratios in addition to a control sample representing the 100% millet (Table 1).

**Table 1:** Formulation of *Ndaleyi* composite flours.

| S/N | SAMPLE | MILLET (%) | BAMBARA NUT (%) |
|---|---|---|---|
| 1 | MBN1 | 90 | 10 |
| 2 | MBN2 | 80 | 20 |
| 3 | MBN3 | 70 | 30 |
| 4 | MBN4 | 60 | 40 |
| 5 | MBN5 | 50 | 50 |
| 6 | MN | 100 | 0 |

* M = Millet, $MBN_1$ = Millet bambaranut

## Proximate composition

Proximate composition of *Ndaleyi* (millet stiff forage) sample of *Ndaleyi* (millet stiff forage) was evaluated for moisture, protein, fat, ash and crude fiber using standard methods of AOAC (2000). Total carbohydrate content was calculated by subtracting the sum of value of the remaining proximate composition from 100.

## Determination of functional properties of *Ndaleyi* (millet stiff forage)

The functional properties (Bulk density, Water absorption capacity, Swelling, Solubility and PH) of samples were determined based on standard methods of the Association of Official Analytical Chemist AOAC (2000).

## Determination of mineral contents of *Ndaleyi* (millet stiff forage)

The minerals content of each sample was carried out to determine the concentration by the used of atomic absorption spectrophotometer (Perkin A Analyst 400SP.). The phosphorus content was determined with the use of flame photometry according to AOAC, (2004).

## Determination of vitamins

Using HPLC to determine vitamin premix and fortified sample by extracting vitamin with 0.1%. (w/v) of ascorbet and ethylene diamine tetra-acetic acid (EDTA) solution followed by eluting using gradient mobile phase consisting of 0.0390 triflouro acetic acid aqueous solution (PH 2.5).

## Sensory evaluation of *Ndaleyi* (millet stiff forage)

The sensory evaluation was conducted by a panel of fifteen (untrained) judges drawn from staff and students of Aliko Dangote University of Science and Technology, Wudil. The samples of (millet stiff forage)) were rated for thickness, colour, flavour, texture and overall acceptability based on nine point hedonic scale where 9 representing like extremely and 1representing dislike extremely as described by Larmond (1976), Ihekoronye and Ngoddy (1985). The panelists were served in white and transparent glass cups and were asked to rinse their mouth with water before next serving. The sample were coded and kept far apart to avoid overcrowding and for independent judgment.

### Statistical analysis

All experimental data obtained were subjected to analysis of variance (ANOVA) procedure of SPSS version 15.0 (SPSS, 2006) at 5% level of significant.

## RESULTS AND DISCUSSION

### Proximate composition of *Ndaleyi* (millet stiff forage) produced from pearl millet and bambaranut flour

Table 2 showed the proximate composition of *ndaleyi* (millet stiff forage). Moisture content ranged from 10.30 to 9, 16%, ash 1.97 to 0.18%, 14.63 to 9.68%, fat ranged from 8.73 to 4.85%, fibre 7.10 4.00% and carbohydrate from 71.37 to 58.51%. This implies that sample $MBN_3$ had the highest moisture content.

**Table 2:** Proximate composition of Ndaleyi (millet stiff forage) produced from Pearl millet and bambaranut flour (%).

| Samples | Moisture | Ash | Protein | Fat | Fibre | Carbohydrates | Energy |
|---|---|---|---|---|---|---|---|
| $MBN_1$ | 9.47±0.52$^e$ | 0.76±0.01$^e$ | 10.14±0.0$^e$ | 5.07±0.06$^e$ | 4.26±0.10$^e$ | 70.30±0.0$^b$ | 367.39±0.01$^d$ |
| $MBN_2$ | 9.60±0.63$^d$ | 0.78±0.01$^d$ | 10.66±0.0$^d$ | 5.10±0.01$^d$ | 4.30±0.11$^d$ | 69.56±0.0$^c$ | 366.78±0.01$^e$ |
| $MBN_3$ | 10.30±0.50$^a$ | 1.10±0.01$^c$ | 11.14±0.0$^c$ | 6.10±0.01$^c$ | 5.20±1.01$^c$ | 66.16±0.0$^d$ | 364.10±0.01$^f$ |
| $MBN_4$ | 9.88±0.47$^c$ | 1.21±0.01$^b$ | 13.12±0.0$^b$ | 8.65±0.01$^b$ | 7.10±0.21$^a$ | 60.58±0.0$^e$ | 372.65±0.01$^a$ |
| $MBN_5$ | 9.16±0.29$^f$ | 1.97±0.01$^a$ | 14.63±0.0$^a$ | 8.73±0.01$^a$ | 7.00±0.30$^b$ | 58.51±0.0$^f$ | 371.13±0.01$^b$ |
| M | 9.92±0.54$^b$ | 0.18±0.01$^f$ | 9.68±0.01$^f$ | 4.85± 0.01$^f$ | 4.00±2.00$^f$ | 71.37±0.0$^a$ | 367.85±0.01$^c$ |

Values are means ± standard deviation of three replicates, followed by the same superscripts within the column are not significantly different at (P≥0.05), level* M **=** Millet**,** MBN = Millet and bambaranut

The moisture content of nadelyi produced from the composite flour of millet and bambaranut flour was significantly different (P≥0.05). It was observed that the moisture content of the *ndaleyi* varied with increased rate of substitution, while the dry matter content increased gradually. The variations in tmoisture contents of the *ndaleyi* may be due to the increase in protein content of the *ndaleyi* as a result of the addition of bambaranut flour. Ash content showed an increase with the rate of substitution with bambaranut flour, with sample $MBN_5$ having the highest ash content of 1.97%. This showed that the *ndaleyi* would be a source of high energy and nutrient dense food for consumers. The addition of bambaranut flour to millet flour was expected to increase the protein content of the final product, since legumes generally contain more proteins than cereals. Addition of legume flour on millet flour cooked products improved the essential amino acid balance of such foods. Protein content also increased with an increase with the rate of substitution with bambaranut flour, sample $MBN_5$ had the highest protein 14.63% with the least sample goes to the control (100% millet) 9.68%. Protein was reported to have some functional properties such as water sorption, viscosity, elasticity, formability, foam stability and fibre formation (Sunful *et al*., 2010; Dixit *et al*., 2011). The capability of the proteins of these flours to bind with oil makes it useful in food system where optimum oil absorption is desired. Fat contents also increased with increase in bambaranut addition when compared with the control. Crude fibre contributes to the health of the gastrointestinal system and metabolic system in human; increased in crude fibre and ash content could be from bambaranut flour addition. This implies that the *ndaleyi* would be a source of high energy and nutrient dense food for consumers. The addition of bambaranut flour to millet flour was expected to increase the protein content of the final product, since legumes generally contain more proteins than cereals. Carbohydrate showed a decreased with increase with the rate of substitution from 71.37 to 58.51%.this shows that as the rate of substitution increases, the carbohydrate decreased with increased in protein content.

### The functional properties of *Ndaleyi* (millet stiff forage) produced from pearl millet and bambaranut flour

Table 3 shows the functional properties of ndaleyi. The bulk density ranged from 0.50 to 0.40(g/ml), water absorption capacity from 140.0 to 70.0(%), swelling capacity from 436.67 to 313.67 (%) and ph ranged from 4.86 to 4.26.bulk density shows a significant different (P≥0.05). Variation were observed in the bulk density of *Ndaleyi* with sample $MBN_3$ 0.50(g/ml) was higher in bulk density and sample M was the least with 0.40(g/ml). Bulk density depends on the particle size and initial moisture content of the flour, this shows that fine particles size and high moisture content leads to a higher bulk density**.** Bulk density of flour was reported to increase with increased in starch content Bhattackaya and Prakash, (1994). Water absorption capacity of ndaleyi was also significant (P≥0.05). This also varied with the rate of substitution with bambaranut flour. Sample $MBN_4$ had the highest water absorption capacity. The increase in temperature caused an increase in the movement of the flour molecules, thereby allowing more samples to be

**Table 3:** The functional properties of Ndaleyi (millet stiff forage) produced from Pearl millet and bambaranut flour

| Samples | Bulk density (g/ml) | Water absorption capacity (%) | Swelling capacity (%) | PH |
|---|---|---|---|---|
| **$MBN_1$** | 0.46±0.08[d] | 50.10±1.00[f] | 320.67±26.10[c] | 4.26±0.32[e] |
| **$MBN_2$** | 0.40±0.08[e] | 120.20±0.01[b] | 313.67±15.18[e] | 4.85±047[b] |
| **$MBN_3$** | 0.50±0.10[a] | 120.00±2.01[c] | 285.35±38.75[f] | 4.72±0.83[c] |
| **$MBN_4$** | 0.49±0.08[b] | 140.00±0.20[a] | 326.33±29.23[b] | 4.86±0.82[a] |
| **$MBN_5$** | 0.48±0.07[c] | 100.00±0.03[d] | 313.69±15.18[d] | 4.61±1.20[d] |
| **M** | 0.40±0.10[e] | 70.00±1.01[e] | 436.67±30.56[a] | 4.17±0.41[f] |

Values are means ± standard deviation of three replicates, followed by the same superscripts within the column are not significantly different at (P≥0.05), level* M **=** Millet**,** MBN = Millet and bambaranut

**Table 4:** Mineral contents of Ndaleyi (millet stiff forage)) produced from Pearl millet and bambaranut flour (mg/100g).

| Samples | Calcium | Iron | Potassium | Magnesium | Manganese | Sodium |
|---|---|---|---|---|---|---|
| $MBN_1$ | 43.68±0.21[c] | 11.02 ±0.08[c] | 445.75±1.41[f] | 314.57±0.56[c] | 1.23±0.02[d] | 11.28±0.05[e] |
| $MBN_2$ | 43.87±0.08[b] | 11.29±0.05[a] | 466.90±0.54[a] | 316.67±0.15[a] | 1.17±0.05[e] | 11.37±0.00[d] |
| $MBN_3$ | 42.49±2.83[e] | 11.21±0.07[b] | 455.84±16.33[d] | 313.82±2.15[d] | 1.64±0.15[a] | 11.78±0.12[a] |
| $MBN_4$ | 43..37±0.13[d] | 10.62±0.15[e] | 455.64±08.53[e] | 312.05±0.94[e] | 1.28±0.00[c] | 11.44±0.08[c] |
| $MBN_5$ | 44.76±2.70[a] | 10.94±0.07[d] | 460.06±18.30[c] | 314.80±5.18[b] | 1.55±0.13[b] | 11.46±1.00[b] |
| M | 39.09±2.14[f] | 8.92±0.00[f] | 466.47±05.60[b] | 311.32±0.23[f] | 1.20±0.09[f] | 10.90±1.02[f] |

Values are means ± standard deviation of three replicates, followed by the same superscripts within the column are not significantly different at (P≥0.05), level* M **=** Millet**,** MBN = Millet and bambaranut

dispersed in the solvent (Gbadamosi and Oladeji, 2013). The higher water absorption capacity of flour could be attributed to the presence of higher amount of carbohydrates (starch) and fibre in the flour. Water is a basic component that helps to get a homogenous mixture of other components in dough, and providing it with a desired viscoelastic structure as well as very effective on final product quality. Water as a dissolving agent for many organic or inorganic substances is a substance that helps in dissolving hydrophilic components such as salt, sugar and insoluble proteins and forms gluten by hydrating insoluble proteins in water (Elgun and Ertugay, 2005). Water holding behaviour may be a function of several parameters including size, shapes, conformational characteristics, hydrophilichydrophobic balance in the starch molecule, lipids and carbohydrates associated with the proteins thermodynamic properties of the system physicochemical environment, solubility of starch molecules and others (Falade & Okafor, 2013). Variations in swelling capacity of nadelyi with sample M with the highest 436.67% and the least attributed to sample $MBN_3$ 285.35%. The swelling capacity of flours depend on the variety and particle size of the flour (Suresh, 2013). Significant difference (P≥0.05) existed in the mean solubility of the blends. Variations also occurred in the ranged of ph value, with sample $MBN_4$ had a ranged of PH of 4.86 and that of $MBN_1$ had 4.26 respectively.

### Mineral contents of *Ndaleyi* (millet stiff forage) produced from Pearl millet and bambaranut flour

Table 4 showed the mineral content of the ndaleyi produced from pearl millet and bambaranut flour. Calcium ranged from 44.76 to 39.09 (mg/100g), iron from 11.29 to 8.92 (mg/100g), potassium from 466.90 to 445.47 (mg/100g), magnesium ranged from 316.67 to 311.32 (mg/100g), manganese 1.64 to 1.20 (mg/100g) and sodium 11.78 to 10.90 (mg/100g). This shows that the mineral contents were all significant (P≥0.05). From the results obtained, the different in the formulations shows significant increment in the minerals content in the production of *ndaleyi* using incorporation of bambaranut flour, Variation in values were also observed in all the mineral content as shown in table 3.3. Sample $MBN_5$ had the highest calcium content of 44.76 (mg/100g) when compared with the control M 39.09 (mg/100g), Calcium is required to assist bone growth and formation. It aids in controlling muscle and nerve activity as well as preventing osteoporosis (Vali Pasha *et al.*, 2018). Sample $MBN_2$ had 11.29 (mg/100g) iron and the control sample had 8.92 (mg/100g). Lower value attributed to the control was as result of substitution with bambaranut flour. Sample $MBN_2$ had the highest potassium content of 466.90 (mg/100g) and sample $MBN_1$ had the lowest of 445.47 (mg/100g). Magnesium content of ndaleyi with bambaranut shows that sample $MBN_2$ had the highest value 316.67 (mg/100g) when compared with the control M 311.32 (mg/100g). Sample $MBN_3$ shows that manganese and sodium had the highest values of 1.64 and 11.78 (mg/100g) while the control values M had 1.20 and 10.90 (mg/100g). According to Ameh *et al.* (2013), minerals serve crucial roles in the neurological system, other cellular functions, water balance, and structural system (such as skeletal).

### Vitamins content of *Ndaleyi* (millet stiff forage) produced from Pearl millet and bambaranut flour.

Table 5 shows the water soluble vitamins values in

**Table 5:** Vitamins content of Ndaleyi (millet stiff forage)) produced from Pearl millet and bambaranut flour (µg).

| Samples | Vitamin c | Thiamine | Riboflavin |
|---|---|---|---|
| $MBN_1$ | 18.77±1.02[a] | 0.70± 0.13[c] | 0.35±0.66[f] |
| $MBN_2$ | 13.49±1.02[b] | 0.69±0.04[d] | 0.36±0.05[e] |
| $MBN_3$ | 12.91±2.02[c] | 0.78±0.06[b] | 0.43±0.06[d] |
| $MBN_4$ | 12.91±1.02[c] | 0.50±0.06[e] | 0.56±0.06[c] |
| $MBN_5$ | 12.28±0.66[d] | 0.83±0.41[a] | 0.63±0.06[b] |
| M | 12.28±0.30[d] | 0.43±0.41[f] | 0.70±0.50[a] |

Values are means ± standard deviation of three replicates, followed by the same superscripts within the column are not significantly different at (P≥0.05), level* M **=** Millet**,** MBN = Millet and bambaranut

**Table 6:** Acceptability of Ndaleyi (millet stiff forage) produced from Pearl millet and bambaranut flour

| Samples | Thickness | Colour | Flavour | Texture | Overall Acceptability |
|---|---|---|---|---|---|
| $MBN_1$ | 6.40±1.29[d] | 7.00±1.51[d] | 7.00±1.51[b] | 7.54±0.01[b] | 6.90±1.21[c] |
| $MBN_2$ | 8..33±1.89[a] | 8.40±1.21[a] | 7.00±1.51[b] | 7.33±1.21[c] | 8.20±1.00[a] |
| $MBN_3$ | 6.67±1.93[c] | 7.23±1.31[c] | 7.00±1.51[b] | 7.16±1.00[d] | 6.50±1.03[d] |
| $MBN_4$ | 5.20±1.93[e] | 5.45±1.00[e] | 7.00±1.51[b] | 7.01±1.03[e] | 5.10±2.00[e] |
| $MBN_5$ | 4.60±2.23[f] | 4.90±0.03[f] | 7.00±1.51[b] | 6.90±2.00[f] | 4.20±0.11[f] |
| M | 8.23±0.09[b] | 8.00±1.01[b] | 8.00±2.00[a] | 8.08±1.51[a] | 8.00±1.51[b] |

Values are means ± standard deviation of three replicates, followed by the same superscripts within the column are not significantly different at (P≥0.05), level* M = Millet, MBN = Millet and bambaranut

ndaleyi. Vitamin c ranged from 18.77 to 12.28 µg, thiamine from 0.83 to 0.43 µg and riboflavin ranged from 0.70 to 0.35 µg. Vitamin content of the nadaleyi are significant (P≥0.05). This implies that samples containing vitamin c content decreased with the rate of substitution with bambaranut flour, with sample $MBN_1$ had the highest value of 18.77 µg thiamine showed a variation in the range of values with bambaranut flour addition, while riboflavin had an increased in values as the rate of substitution increased. These vitamins contribute to overall health and well-being (Adeyemi *et al.,* 2018).

## Acceptability of *Ndaleyi* (millet stiff forage)) produced from Pearl millet and bambaranut flour.

Table 6 shows the sensory scores of ndaleyi produced from different formulations. Thickness, colour, flavor, texture and overall acceptability are significant (P≥0.05). Thickness ranged from 8.33 to 4.60, colour from 8.40 to 4.90, flavor from 8.00 to 7.00, texture from 8.08 to 6.90 and overall acceptability ranged from 8.20 to 4.20.sample $MBN_2$ obtained the best thickness 8.33 and colour 8.40 of the ndaleyi when compared with the control M 8.23and 8.00. Flavor and texture varies significantly with the control M 8.00 and 8.08 which was due to the substitution of millet flour and bambaranut flour. The mean comparison scores of different attributes like thickness, colour, flavor, texture, and overall acceptability were significant (P≥0.05). It was found that based on the overall acceptability that sample $MBN_2$ was overall accepted when compared with the control followed by samples $MBN_1$ and $MBN_3$ This also showed that all the formulations shows a significant difference based on the sensory attributes such as thickness, colour, flavor, texture and overall acceptability.

## Conclusion and Recommendation

Ndaleyi (millet stiff forage) produced from the blends of millet and bambaranut flour was the first of its kind, which contains higher amount of protein, mineral and some water soluble vitamins (vitamin c, thiamine, riboflavin) that satisfied the dietary requirement of humans. This showed that the *ndaleyi* is a source of high energy and nutrient dense food for consumers. It was found that based on the overall acceptability that sample $MBN_2$ was overall accepted when compared with the control followed by samples $MBN_1$ and $MBN_3$ This also showed that all the formulations shows a significant difference based on the sensory attributes such as thickness, colour, flavor, texture and overall acceptability. Policy should be implemented towards nutritional programme on these products.

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