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PROXIMATE ANALYSIS, SENSORY EVALUATION AND PRODUCTION OF BREAD FROM FINGER MILLET AND WHEAT FLOUR

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ABSTRACT

Finger millet, is a unique cereal with high nutritional quality, particularly in African countries such as Ethiopia, Zimbabwe, and South Asian country. This study is aimed to determine the nutritional composition and sensory evaluation of Bread made from finger millet and wheat composite flours. The proximate analysis of wheat, finger millet flours and bread produced by combination of the two flours at ratio of 95:5, 90:10 and 80:20 were conducted, the results revealed improved nutritional quality of the product as the moisture contain was significantly different (p<0.05) at ration of 95:5 while at other ratios there was no difference (p<0.05) compared to the 100% finger millet bread, there were also significant improvement (p<0.05) on protein content of the bread produced at ratio of 80:20, however the fat, fiber, Ash, carbohydrate and calories of the product were also higher compared to 100% finger millet bread. The mean scores of sensory evaluation showed that all the extruded products prepared from composite flours were within the acceptable range. Therefore it can be concluded that products of combined mixture of finger millet and wheat flours are more nutritious than products of 100% finger millet products. And consumption of such products are highly encouraged and less course effective.

INTRODUCTION

Finger millet (FM) is a cereal grain that belongs to the family *Poaceae* and is a gluten-free grain (Gebre, 2019). FM is ranked 4th among other millets in the world in importance after sorghum (*Sorghum bicolor*), pearl millet (*Pennisetum glaucum*) and foxtail millet (*Setaria italica*). It is cultivated in some parts of African countries such as Ethiopia, Zimbabwe, and South Asian country (Opole, 2019). FM is referred to as *mufhoho* (Tshivenda) in South Africa (Ramashia *et al.,* 2019) and *dagussa* in Ethiopia (Kumar *et al.,* 2016). FM consists of different varieties: black, reddish-brown, and white (Gebre, 2019). It contains nutritional elements which are easy to digest thus a major source of food for pregnant women, the sick, lactating mothers, children and diabetics (Tracyline *et al*., 2021). It is a rich source of calcium which strengthens bones, and teeth. FM has potential health benefits in all age groups and people with chronic diseases (Ramashia *et al.,* 2019). The grains contain zinc (Zn), amino acids, and vitamin B complex. Usually cultivated in a wide range of soils and climates and because of their short growing seasons, they are of specific importance in semiarid regions. Convenient foods are commercially prepared processed foods, which are designed for the ease of preparation and consumption. Utilization of millets is restricted due to non-availability of processed foods in ready to eat form. Millets can be effectively utilized for developing value added products which can improve the overall diet quality. Millets are small seeded cereals known as nutria cereals which represent rich sources of Phytochemicals and Micronutrients.

Millet grain is now receiving increasing interest from food scientists and nutritionists because of their important contribution to food security and potential health benefits. Supplementation of millet grains with natural food products to enhance their nutritive value is promising and cost effective strategy to combat micro nutrient deficiencies. Millets contain carbohydrates (60-70%), proteins (7-11%), fat (1.5-5%), and crude fibre (2-7%) and are also rich in vitamins and minerals. They are excellent source of B vitamins, magnesium and antioxidants (Singh *et al*., 2012). The grain constitutes about 81% of the minor millets produced in India and rest by kodo millet, foxtail millet, and little millet. Finger millet is a major source of mineral, protein, and carbohydrates that is comparable to other common cereal grain. It is also rich source of minerals having significant amount of phosphorous, calcium and iron.

The direct consumption of millets as food has significantly declined over the past three decades. The major reasons of decrease in consumption are life style changes in rural and urbanization culture, inconveniences in food preparation as demand for processed and convenience food has increased drastically and non-availability of processed products similar to rice or wheat. As well as people spending less time in kitchen because of their busy life schedule (Eneche, 1999). Finger millet can be used for preparation of various nutrient dense recipes which can effectively use for supplementary feeding program. The aim of this study is to determine the nutritional composition of finger millet and it sensory evaluation in production of finger millet bread.

MATERIAL AND METHODS

Sample Collection

Finger millet (*Eleusine coracana L.*) samples, wheat flour and other materials used were purchased from the market.

Sample preparation

Table 1: Proportion of finger millet and wheat flour

SAMPLES	COMPONENTS	BLENDING RATIO (%)
W	Wheat flour	100
F	Finger millet flour	100
W:F	Wheat:Finger millet	95:5
W:F	Wheat:Finger millet	90:10
W:F	Wheat:Finger millet	80:20

Processing of Finger millet flour

The finger millet flour was produced according to the method of Ndife *et al.,* (2011). Briefly; the grains were sorted and cleaned to remove extraneous materials and then weighed. This was followed by washing of the grains and soaking in water for six hour to remove particles. After soaking, the grains were sun dried and thereafter milled and allowed to pass through 60µm mesh size to obtain fine flour.

Preparation of finger millet bread

Finger millet Bread was made by adding cup of water, sugar, dry yeast and butter in a bowl in required composite proportion and kneading is done to make it into smooth and fluffy. Generally kneading and mixing was done in blender equipment. Then knead finger millet flour and wheat flour was taken in a bowl then added xanthangum, egg and olive oil and added to blender for re-blending and good kneading purpose. After blending, baking powder is added along with initial blended butter and sugar paste. The flour blend then was added with water and milk, and was made into shape in the form of dough. The dough is now cut into desired shapes with help of mold. The mold shaped dough are put into bread pan and kept in micro oven at 130°C for 20 min to bake. After baking it is cooled and packed. The sequential steps involved in the preparation of cookies are given below.

Moisture Content

Moisture content was determined according to the method described by (AOAC, 2004). The petri-dishes were washed with distilled water, then dried in electric oven for 4 hours at 105◦c. after then the petri-dishes were removed from the oven and then cooled in the desiccator for 30mins. The petri-dishes were labeled, weighed respectively. 5g of sample were weighed according to the UNBS standard in two replicates. The petri-dishes and the samples were heated in an electric oven for 4hours set at 105°C after the 4hours; the samples were removed from the electric oven transferred to the desiccator to cool to room temperature for 30mins. The petri-dishes and the samples were weighed and the results were recorded. The moisture content was expressed as the moisture percentage.

$$\% \, Moisture = \frac{Weight\ of\ wet\ sample - \ weight\ of\ dry\ sample}{Weight\ of\ wet\ sample} \times 100$$

Ash Content

Ash content was determined according to the method described by (AOAC, 2004). Briefly; the crucibles were cleaned using distilled water and dried in electric oven for 30mins then cooled in desiccator. And labeled for two replicates and weighed. 3g of each sample were weighed (UNBS standard) and recorded.

The crucibles were placed on a hot plate in a fume hood to carbonize the sample. The crucibles were placed in cool muffle furnace for 5hours at 550◦c. After the 5 hours, the muffle furnace was turned off and waited for 3 hours for the temperature to drop to 150°C and transferred to the desiccator to cool for 30mins. The ash content was expressed as percentage of ash.

$$\% \, Ash = \frac{Weight\ of\ sample\ +\ crucible - \ weight\ of\ crucible}{Weight\ of\ sample} \times 100$$

Fat Content

Fat content was determined according to the method described by (AOAC, 2004). Briefly; Samples were dried in the electric oven at 105°C for 4 hours. The aluminum cups were weighed and 3g of dried samples were added. A thin layer of cotton wool was put on top of the sample thimble, 60 ml of petroleum ether was measured and transferred to each cups, and then the fat was extracted. After the extraction the cups were put in desiccators and left to cool for 30min. at the end of 30min, each cup was weighed as W3. The fat content was expressed as percentage of fat.

$$\% \, Moisture = \frac{Weight\ of\ extraction\ cup\ +\ residue\ -\ weight\ of\ extraction\ cup}{Weight\ of\ sample} \times 100$$

Protein Content

Protein content was determined according to the method described by (AOAC, 2004). One gram of each sample was introduced into a digestion flask. 20ml of concentrated sulphuric acid was added to the sample and fixed to the digester for 8h until a clear solution was obtained. The cooled digest was transferred into 100ml volumetric flask and made up to mark with distilled water. Distillation apparatus was set and rinsed for 10mins after boiling. 20ml of 4% boric acid was pipetted into conical flask. Five drops of methyl red were added to the flask as indicator and the samples were diluted with seventy-five (75ml) distilled water. 10ml of the digest was made alkaline with 20ml of NaOH (20%) and distilled. The steam exit of the distillatory will be closed and the change of color of boric acid solution to green was timed. The mixture was distilled for 15min. The filtrate was titrated against 0.1 N-hydrochloric acids, (HCl). The protein value was determined using 6.25 as conversion factor, and the result expressed as amount of crude protein.

$$\% \, Crude\ protein = \frac{0.014\,(\frac{MeN}{100g}) \times T_V \times V_D \times N}{W_S V_A} \times 100 \times C_F$$

Where;

W_S = Weight of sample analyzed,

T_V = Titre value blank,

V_D = Total volume of digest,

N = Concentration of H_2SO_4,

V_A = Volume of digest distilled.

C_F = Protein conversion factor

Crude Fiber Content

Crude fiber content was determined according to the method described by (AOAC, 2004). Two grams of each sample was boiled under reflux for thirty minutes with 200 ml of solution containing 1.25 g of K' LMA per 100ml of the solution. Solution was filtered using linen on a flaunted funnel and then washed with water until the washing was no longer acidic. Residue was then transferred to beaker and boiled for 30 minutes with 100ml of solution. The final residue was filtered using a thin but closer pad of washed and ignited asbestos in Gosh crucible. The residue was dried in electric oven and weighed. The residue was incinerated, cooled, and weighed.

$$\% \, Crude\ Fibre = \frac{Weight\ of\ sample\ +\ Crucible -\ weight\ of\ sample\ crucible\ +\ Ash}{Weight\ of\ sample} \times 100$$

Carbohydrate Content

Carbohydrate content of the flours was determined using the difference formula described by (Hadimani *et al.,* 1993). % carbohydrate = 100 − % (protein + fat + fiber + ash + moisture content).

Energy Value

The energy value of all samples was calculated using at water valves: 4, 9, 4 as follows (4 × protein, 9 × fat, and 4 × carbohydrate) and expressing the sum of products in (4 × protein + 9 × fat + 4 × carbohydrate kilocalories). This was then converted to kilo joules (KJ) using a conversion factor = 4.184 (Approx. 4.2) to multiply the energy values given in Kcal (MAFF, 1981).

Sensory Evaluation

Sensory evaluation was carried out using a 5-point hedonic scale. 10 semi trained panelist from the department of biochemistry, Bayero University Kano, were used. The 5-point hedonic scale ranged from like a lot (5) to dislike a lot (1). The sample was presented in identical coded containers. Each sample evaluated for Appearance, Aroma, Taste, and Texture. Samples were rated alongside the control sample (100% wheat flour Biscuit).

STATISTICAL ANALYSIS

The results obtained were analyzed using one way Analysis of Variance (ANOVA). Mean were separated using multiple range Test. Significance difference accepted at P<0.05 using statistical product for service solution (SPSS) version 20.

RESULTS AND DISCUSSION

Results

The Proximate analysis of both the Finger millet and wheat flour were obtained and presented in table 1. However the Proximate analysis of bread produced from finger millet and wheat flour were also presented in table 2. The sensory evaluations of both the bread produced from finger millet and wheat flour were carried out, where Aroma, Teste, Appearance and Texture of both the two products were presented in figure 1, 2, 3 and 4 respectively.

Table 1: Proximate content of Finger millet and wheat flour

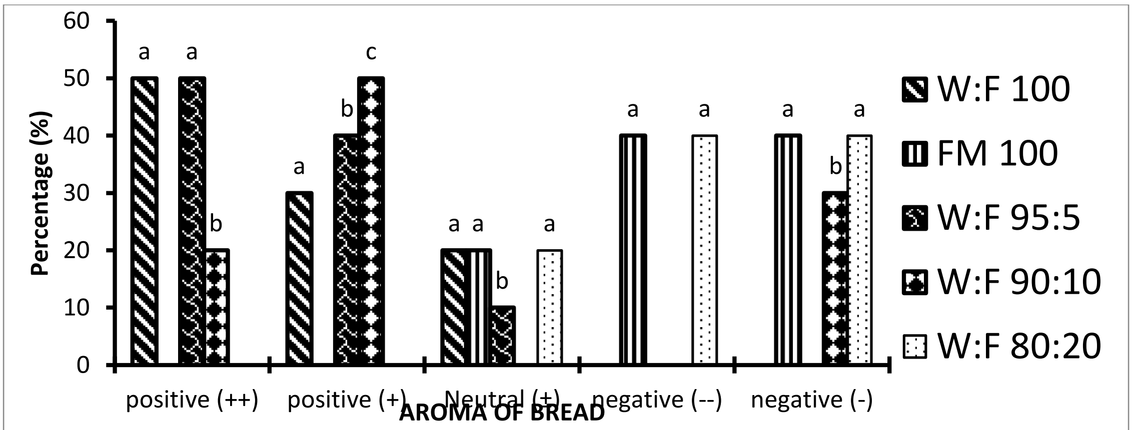
Sample (%)	Moisture (%)	Protein (%)	Fat (%)	Fibre (%)	Ash (%)	Carb (%)	Energy
W:F 100	10.53 ± 1.45[a]	10.75 ± 0.78[a]	2.52 ± 1.00[a]	1.77 ± 0.80[b]	1.47 ± 0.31[a]	72.97 ± 1.46[a]	357.52 ± 3.04[a]
FM 100	14.13 ± 0.60[b]	7.97 ± 0.67[b]	1.43 ± 0.21[a]	4.09 ± 0.37[a]	2.83 ± 0.25[b]	73.47 ± 1.36[a]	352.95 ± 4.62[b]
W:F 95:5	8.88 ± 1.07[a]	10.52 ± 1.30[ab]	1.87 ± 0.33[a]	1.89 ± 0.34[b]	2.20 ± 0.61[ab]	74.44 ± 1.32[a]	356.63 ± 5.23[a]
W:F 90:10	10.17 ± 1.16[a]	9.64 ± 1.22[ab]	1.45 ± 0.25[a]	2.00 ± 0.06[b]	2.32 ± 0.69[ab]	74.42 ± 3.23[a]	349.32 ± 6.80[a]
W:F 80:20	10.31 ± 1.74[a]	9.59 ± 1.03[ab]	1.37 ± 0.33[a]	2.10 ± 0.19[b]	2.83 ± 0.25[b]	73.81 ± 3.34[a]	345.89 ± 6.85[a]

Data are presented as Mean ± Standard deviation (n=5). Values with the same superscript letter(s) along the same column are not significantly different ($P < 0.05$). W:F 100 = wheat and finger millet at 100%, FM = finger millet at 100%, W:F 95:5 = wheat at 95% and finger millet at 5%, W:F 90:10 = wheat at 90% and finger millet at 10%, W:F 80:20 = wheat at 80% and finger millet at 20%.

Table 2: Proximate analysis of bread produced from finger millet and wheat flour

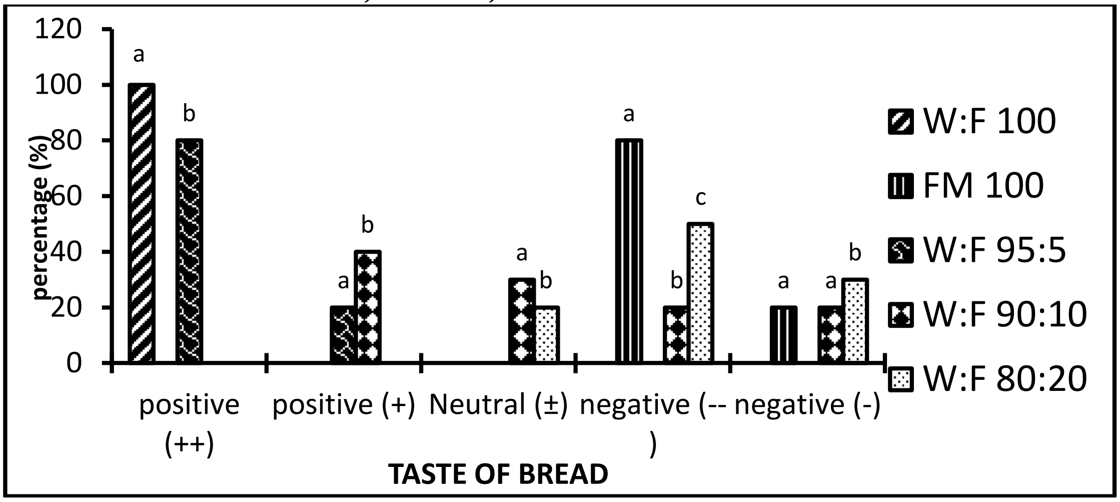
Sample (%)	Moisture (%)	Protein (%)	Fat (%)	Fibre (%)	Ash (%)	Carb (%)	Energy
W:F 100	4.88 ± 0.08[a]	17.87 ± 0.27[a]	7.87 ± 0.06[a]	3.91 ± 0.12[a]	3.12 ± 0.15[a]	68.24 ± 1.43[b]	396.86 ± 1.03[c]
FM 100	4.75 ± 0.13[a]	17.10 ± 0.05[b]	7.28 ± 0.29[a]	3.26 ± 0.21[b]	3.05 ± 0.06[a]	67.87 ± 0.79[b]	391.23 ± 4.14[c]
W:F 95:5	4.38 ± 0.10[b]	17.25 ± 0.11[b]	7.25 ± 0.48[a]	3.54 ± 0.37[ab]	3.33 ± 0.18[a]	68.45 ± 0.16[b]	394.46 ± 7.10[c]
W:F 90:10	4.73 ± 0.06[a]	16.58 ± 0.10[c]	7.16 ± 0.36[a]	3.57 ± 0.05[ab]	3.13 ± 0.15[a]	67.59 ± 0.29[b]	393.50 ± 5.26[c]
W:F 80:20	4.88 ± 0.08[a]	17.87 ± 0.27[a]	7.87 ± 0.07[a]	3.91 ± 0.12[a]	3.12 ± 0.15[a]	68.24 ± 1.43[b]	396.86 ± 1.03[c]

Data are presented as Mean ± Standard deviation (n=5). Values with the same superscript letter(s) along the same column are not significantly different ($P < 0.05$). W:F 100 = wheat and finger millet at 100%, FM = finger millet at 100%, W:F 95:5 = wheat at 95% and finger millet at 5%, W:F 90:10 = wheat at 05% and finger millet at 10%, W:F 80:20 = wheat at 80% and finger millet at 20%.



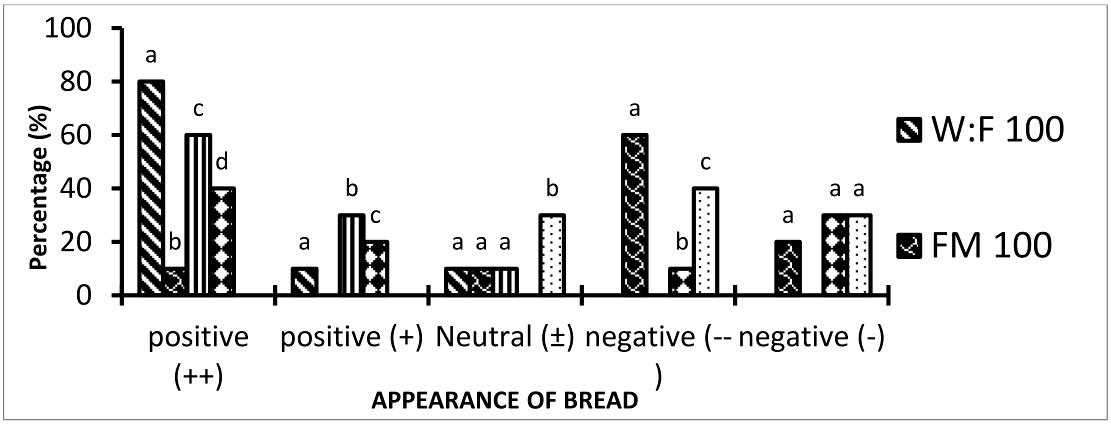
Values with the different letter (s) are significantly different (at $p < 0.05$).

Figure 1. The percentage of Aroma in the sensory evaluation of Bread produced from finger millet and wheat flour.



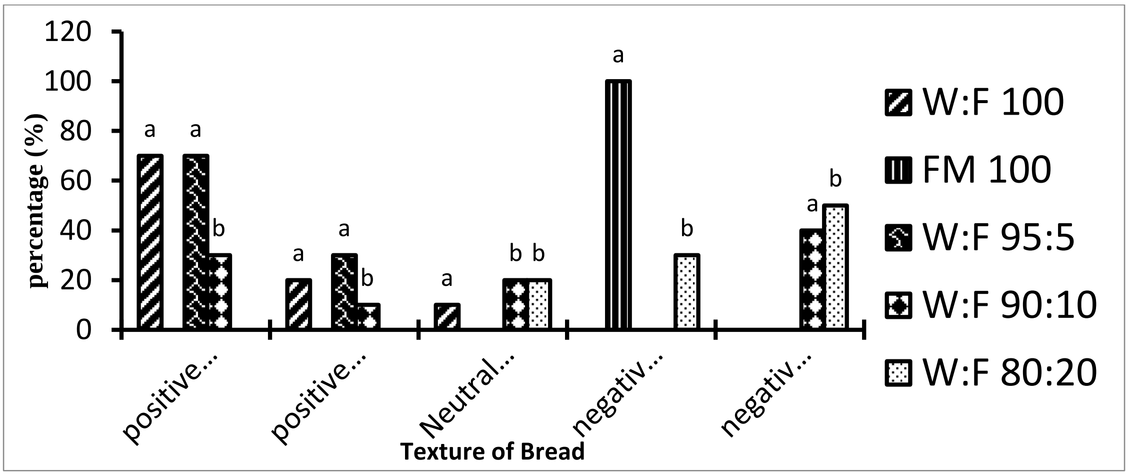
Values with the different letter (s) are significantly different (at $p < 0.05$).

Figure 2. The percentage of Taste in the sensory evaluation of Bread produced from finger millet and wheat flour.



Values with the different letter (s) are significantly different (at $p < 0.05$).

Figure 3. The percentage of Appearance in the sensory evaluation of Bread produced from finger millet and wheat flour.



Values with the different letter (s) are significantly different (at $p < 0.05$).

Figure 4. Bar chart representing percentage of Texture in the sensory evaluation of Bread produced from finger millet and wheat flour.

DISCUSSION

The results obtained for moisture content shows that finger millet flour 100% has the highest value compared to wheat flour as 14.13 ± 0.60% and 10.53 ± 1.45% respectively, however the mixture of the two flours at ratio of 20:80 (FMF:WF) shows lower moisture content compared to 100% finger millet flour.

Therefore from the results obtained wheat flour with lower moisture content and the combination of the flours has better shelf stability than the 100% finger millet flour, as Low moisture indicates that flours can be stored for longer periods without spoilage, hence showing better shelf stability. This is a good indicator of the quality of the dry flour which contributes to low residual moisture in baked products. Such desirable quality is important as it leads to the reduction of microbial growth leading to flours that can be stored in appropriate packaging material under good conditions (Adegunwa *et al.,* 2014; Falade *et al.,* 2014). The ash content of finger millet flour was significantly higher than wheat flour with values of 2.83 ±0.25 and 1.47 ± 0.31 respectively. This value indicate that finger millet can be considered as good sources of minerals when compared to values (2 – 10 %) obtained for cereals and tubers. The results show similarity with the report of Ramashia *et al*, 2021, that ash content of native finger millet range from 3.71± 0.14 to 5.55 ± 3.47%. This suggests that finger millet flour could probably provide essential, valuable and useful minerals needed for good development of the body. The crude fiber also was significantly different ($p<0.05$) than wheat flour with values of 4.09 ± 037 and 1.77 ± 0.80 respectively, however in another study conducted by Ramashia *et al*, (2021) on native and fortified finger millet reported the crude fiber content to be from 1.90 ± 0.01 to 2.16 ± 0.51%, similarly David *et al.* (2014) reported the value of 3.10% crude fiber from finger millet. This suggests that finger millet could provide additional dietary fibre in the diet. The results obtained for protein (10.75%, 7.97%) fat (2.52% , 1.43%) and calories (357.52, 352.95) shows that wheat flour was significantly higher than finger millet flour as presented in table 1, however the carbohydrate content (73.47%, 72.97%) of finger millet flour was higher than wheat flour. However, the value is closely similar with value for Kersting's groundnut (73.9 ± 0.15). This indicates that, it could serve as a good source of energy. Therefore these results can be compared with those of protein rich foods such as soyabean, cowpeas, Kersting's groundnut, pigeon peas, Bambara groundnut (Aremu *et al.*, 2006b) and some soil seeds. Finger millet could therefore be used as an alternative source of protein in diets/protein supplement especially in nations like Nigeria where the majority of the populace live on starchy food and cereals.

The panels of semi-trained judges consisting of 10 members were given the extruded snack food samples for evaluation of organoleptic characteristics viz. appearance, colour, taste, texture. The average score recorded by judges was considered, presented, and discussed (Table 3). The mean scores of sensory evaluation showed that all the extruded products prepared from composite flours were within the acceptable range, while the extruded product prepared from composite flour sample; W:F 100: (92%), FM 100: (45%), W:F 95:5 (86%), W:F 90:10 (75%), WF 80:20 (70%). The study shows that Sample W:F has significantly better appearance, aroma, taste and texture. It was revealed from the scores of the overall acceptability that millet mixed with grains can be successfully used to produce a better acceptable product.

CONCLUSION

The finger millet grain can be seen to contribute to food security, especially for low income populations across the globe. This study shows that incorporation of finger millet flour combined with wheat flour not only made it easy to create varieties of foods from finger millet but also shows the nutritional importance of the finger millet and the benefit to human health. This is more so when comparing studies on finger millet with that of other major cereals such as maize, wheat and rice. More importantly the proximate analysis revealed that products of combined mixtures of finger millet and wheat flours were highly nutritious and can effectively reduce the course of production when compared to the uses of 100% wheat flour. Therefore based on the results obtained from this study, it can be suggested that utilization and commercialization of finger millet food products has to be encourage.

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