Food and Nutrition Sciences, 2020, 11, 990-1002
https://www.scirp.org/journal/fns
ISSN Online: 2157-9458
ISSN Print: 2157-944X

Assessing Consumer Acceptability of Composite Cassava (*Manihot esculenta*) Bread

Gilbert Owiah Sampson

Faculty of Vocational Education, University of Education, Winneba, Kumasi, Ghana
Email: gosampson@uew.edu.gh

How to cite this paper: Sampson, G.O. (2020) Assessing Consumer Acceptability of Composite Cassava (*Manihot esculenta*) Bread. *Food and Nutrition Sciences*, **11**, 990-1002.
https://doi.org/10.4236/fns.2020.1111070

Received: July 3, 2020
Accepted: November 21, 2020
Published: November 24, 2020

Abstract

Cassava has gained attention as a potential industrial crop. The roots are processed into cassava flour for bakery and confectioneries. With the ever increasingly expensive level of wheat flour import for bread production in developing countries like Ghana, the need for other highly nutritious yet readily available and less expensive source of composite flour is important. The aim of the study was to investigate consumer acceptability of bread developed from cassava flour and wheat flour. A 4 × 3 factorial design was used to develop bread samples (A = 100% wheat flour, control, B = 10% cassava flour + 90% wheat flour, C = 20% cassava flour + 80% wheat flour and D = 30% cassava flour + 70% wheat flour). Sensory evaluation was performed on the bread samples using the 9-point hedonic scale to evaluate sensory attributes like colour, gumminess, mouth-feel, taste, flavour, and overall acceptability. The proximate compositions of the products were also evaluated using the A. O. A. C (2005) official methods. Statistically, there was significant difference among the protein and carbohydrate of all flour products developed. However, the energy content of products with 30% cassava flour replacement was significantly higher than other replicates. The control had the lowest moisture content of 17.5% with product 20% cassava flour replacement having the highest moisture content of 18.2%. In terms of overall acceptability 10% cassava flour replaced bread was rated like extremely ahead of the control sample which was rated as like very much. These results showed that the 10 and 20% wheat/cassava composite flour bread recipe could be a viable alternative to achieve the desired economic, food security and health.

Keywords

Wheat/Cassava Composite Bread, Sensory Evaluation Analysis, Proximate Composition Analysis, Consumer Acceptability

1. Introduction

According to International of Tropical Agriculture (IITA, 2009), Cassava (*manihot esculenta* Crantz) is a perennial woody shrub with edible root, which grows in tropical and subtropical areas of the world. Cassava originated from tropical America and was first introduced into Africa in 1558. Sixty percent of the population of sub-Sahara Africa depends on cassava as a staple food crop [1]. From the past, cassava has been utilized for two main purposes; human food and industrial usage [2].

Food and Agriculture Organization [3] reported that, 228 million metric tones of cassava were produced worldwide in 2007, of which Africa accounted of 52%. Nigeria produced 46 million tones making it the world's largest producer. Cassava is cultivated in all eight regions of Ghana with prevalence in the Eastern and Central regions [3]. Cassava constitutes 22% of the Ghana's agricultural Gross Domestic Product (GDP) and one of its main staple crops with an annual production of about 14.2 million metric tones in FAOSTAT, 2011.

Cassava is primarily produced for its roots which constitute a major and cheap source of carbohydrate in human diet, an important source of energy for the most under developed and developing countries (IFAD, 2004).

According to FAO [3], postharvest losses account for between 3.5 million tones to 4 million tones annually. Another concern is the fact that, cassava contains toxic compounds which require special processing procedures that will eliminate or reduce the levels of cyanogenic glycosides, making the product much safer for human consumption [4].

Processing cassava into dry form is therefore necessary to reduce the moisture content and convert it into a more durable and stable product with less volume, which makes it easier for transportation as well as reducing post-harvest losses. It also aids in eliminating the level of hydrocyanic acid (HCN) and improving the palatability of the food produce [5].

One of the ways of exploiting this technology is by converting the cassava roots into flour to serve as a potential bakery product. Bread has become a staple food and is now one of the most consumed breakfast foods. However, bread has being extensively and/or popularly made from wheat flour owing to its high levels of gluten, which gives the dough sponginess and elasticity.

Wheat has become increasingly expensive owing to the large quantity imported at high costs into the country. A possible solution of the high cost of wheat importation is to introduce the use cassava flour which is locally produced and less expensive raw material, as a potential substitute of wheat flour for bread making among other uses in the Ghanaian community. This possibility when harnessed will go a long way to reduce the hitherto predominant post-harvest losses, which has been on the rise, quoted as 12% in 2011. The possibility of using flours derived from cassava roots and other food resources for producing bread has not been extensively explored in Ghana.

Once cassava flour becomes incorporated and/or accepted in the bakery industry, especially in the production of bread, cassava production would save Ghana billions in foreign exchange from reduced import of wheat and wheat flour. It is therefore challenge to have cassava processed into High Quality Cassava Flour (HQCF) to serve as a suitable substitute to wheat flour.

The purpose of this study therefore was to study the practicality of the production of composite cassava bread (cassava-wheat flour bread) while accessing its acceptability on the consumer market based on sensory evaluation of essential parameters and attributes.

2. Material and Methods

2.1 Research Approach

The research approach used was a quantitative research.

2.2. Raw materials and the Sources

Raw materials used include Sweet cassava bought from a local farmer at Obuasi, in the Ashanti Region. The cassava was harvested in the evening prior to processing into cassava flour. Commercial strong wheat flour (Takoradi mill, Ghana), instance dry yeast, Cook Brand Margarine, granulated white sugar, iodated salt, vanilla essence, and nutmeg were also obtained from Opoku Trading, Adum, in Kumasi.

2.3. Processing High Quality Cassava Flour (HQCF)

A 200 kg weight of cassava was obtained to process the high quality cassava flour (**Figure 1**).

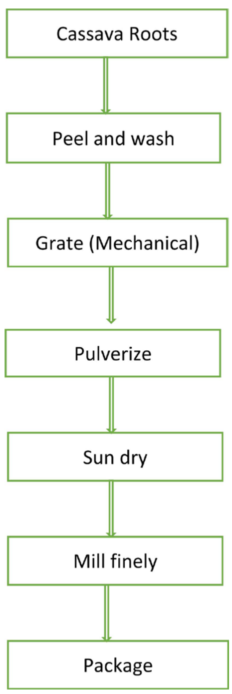

Figure 1. Flow diagram of unfermented cassava flour.

To prepare unfermented cassava flour, the fresh cassava roots was hand peeled, washed and mechanically roughly crushed cassava into about $1.7mm^3$ using a commercial motorised cassava grater. The crushed produce was loaded into a white woven polypropylene sack and using hydraulic press to remove excess water from the cassava mash and in about ten minute times enough water was squeezed out. It lost quite some amount of water and became reasonably dried and was sifted with a traditional gari processing cane-sieve into grits which removed only the large particles and fibres that facilitated drying [6]. The pressed cassava mash was spread thinly (CTA. 2007) on clean greybaft sheets on tables in full sun for about eight continued hours. It was turned periodically during the drying period which promoted quick drying until it was very floury. It was then milled and the flour passed through finest mesh sieve. The flour looked white and was odourless. The flour finally was packaged in cleaned and an airtight moisture-proof plastic container under a lid stored for future used.

2.4. Composite flour Preparation Using Cassava Flour and Wheat Flour

To obtain composite flour from Cassava and Wheat Flour, 10%, 20%, and 30% parts by weight of cassava flour was thoroughly mixed with 90%, 80%, and 70% parts by weight respectively of wheat flour and stored in airtight moisture-proof plastic container.

2.5. Percentages of Wheat Flour Breads

Samples of wheat breads were baked. The control breads were prepared from 100% wheat flour and were used to assess values of cassava composite breads in terms of colour, gumminess, mouth feel, taste, flavour, and overall acceptability.

2.6. Breads Preparation

Bread preparation was conducted using a High-Quality Cassava Flour (HQCF) and Wheat Flour (WF) for baking composite cassava bread and Wheat Flour (FW) for baking the control bread.

All ingredients were weighed using manual scale. The mixing and kneading were done mechanically with a commercial kneading machine until the dough was well developed. Thereafter, the four parts of dough; making the control, 10%, 20%, and 30% were moulded into rounded shaped pieces weighing 25 g each, placed in an already oiled baking pan. The dough was covered with a plain grey baft fabric and left to ferment at room temperature. The numbers of rolls baked were 60 for each part, making 240 in all.

Bread rolls were baked with the ingredients listed in **Table 1**, the proportions expressed as the percentage of flour used. Part of the hard wheat flour was substituted by flour from the High Quality Cassava Flour (HQCF) at replacement levels of 10%, 20% and 30% (**Table 1**). The proportions of the remaining ingredients were not changed. Bread baked with 100% wheat flour was used as control. All four flour samples were baked.

Table 1. Formulation of breads.

Ingredients	Control	10%CF	20%CF	30%CF
Wheat flour (g)	2000	1800	1600	1400
Cassava flour (g)	0	200	400	600
Margarine (g)	700	700	700	700
Instant yeast (g)	5	5	5	5
Sugar (g)	15	15	15	15
Salt (g)	20	20	20	20
Nutmeg (g)	25	25	25	25
Vanilla essence (ml)	10	10	10	10
Liquid (ml)	700	800	900	1000

CF = Cassava flour.

The dough was kneaded mechanically for about 20 minutes, moulded into rounded shape and proofed for 3 hours at room temperature. The rolls were baked in a cabinet type gas oven at 180˚C for 25 minutes. Then, the bread was cooled for 60 min at room temperature of about 35˚C.

2.7. Sensory Evaluation

Breads produced from the composite flours was subjected to sensory evaluation and was compared with control (100% wheat flour) breads at time of sensory evaluation. Breads were assessed by 50 panellists employed from Obuasi municipality which were made up of 20 teachers and 20 students from Obuasi Senior High Technical School, and also 5 bread bakers and 5 bread sellers from Obuasi municipality. Panellists were familiar with bread but were introduced to the individual seven-hedonic rating scale, a score of 1 represented dislike extremely and 7 represented like extremely, for seven sensory attribute namely; appearance, colour, taste, gumminess, flavour, mouth feel and overall acceptability of breads samples. The bread samples were presented in identical containers, coded with 3-digits random numbers served simultaneously to ease the possibility of the panellists to re-evaluate a sample preference. Panellists rinsed their mouths with water after each stage of sensory evaluation to prevent carry-over flavour during tasting.

2.8. Proximate Analysis

The essential chemical constituents of the various product samples prepared (water, ash, crude protein, ether extract (fat), crude fibre and nitrogen-free extract as carbohydrates) was conducted according to the procedure of A.O.A.C. 920.86 (A.O.A.C. 2005).

2.9. Statistical Analyses

A total of 220 of bread rolls were made. All the experiments were replicated in triplicate unless otherwise stated. The coefficient of variability of all the tests was lower than 10%. Analysis of variance (ANOVA) and the linear regressions followed by Turkey's test in addition to the correlations between factors were performed using SPSS 16.0 (SPSS Inc., Chicago, IL, USA). All the calculations were done at the significance level of $p < 0.05$.

3. Results and Discussions

3.1. Descriptive Statistics for Sensory Parameters

3.1.1. Colour

In the study, all the products including the control sample received mean ratings of more than the mid-point mark of 4.5. From the results of the four samples on the colour as presented in **Table 2**, the colour of the product sample with 10% cassava replacement recorded the highest mean rating of 7.68 followed by 20% cassava replacement with a mean rating of 7.43 then the control sample recorded a value of 7.40 with the 30% replacement recording a value of 7.37. The results showed a colour preference order of 10%, 20%, control and 30%.

Colour of bread crust is an important sensory attribute, which can enhance acceptability. The local population thinks that pale coloured bread crust is indicative of improper baking. Besides it is assumed that the brown colour is what imparts nutrients, especially iron on the product. Browning of bread crust is an origin of Millard reactions during baking in the presence of amino acids, reducing sugars, temperature, time of baking and moisture levels of the fermented dough [7].

The results showed that the more cassava flour was substituted in wheat-cassava flour blends, the colour became less brown and so the bread made from the 100% wheat flour was browner than the others. This was expected since the reduced amount of proteins in the breads made from different proportions of the wheat: cassava flour blends meant reduced proteins in the Maillard reactions which is one of the reactions responsible for brown colour. However, these findings are inconsistent with other similar studies where it was reported that cassava flour supplementation in composite bread did not reduce the caramelization process which forms the brown colour during baking [8].

3.1.2. Taste

In **Table 3** is the descriptive statistics of the taste of the four product samples. The taste of the product sample with 10% cassava replacement recorded the highest rating for taste with a mean value of 7.63; followed by 20% replacement was ranked second as far as taste is concerned with a mean value of 7.2, followed by the control sample with mean of 7.13. The taste ranking followed as 10%, 20%, control and 30%. From the results, there is a strong indication that, the bread sample with 10% replacement of wheat by cassava flour gave panellists the highest and the most preferred taste followed by a 20% cassava flour replacement if there was no significance difference between the control and 10% cassava replacement but there was a significant difference between the former (control and 10% cassava replacement) and the 20% and 30% cassava replacement bread samples.

Table 2. Descriptive statistics for colour.

Product/Statistic	Control	10% Replacement	20% Replacement	30% Replacement
Mean (Brown colour)	8.17[b]	7.68[a]	7.43[b]	7.37[b]
Standard Deviation	1.45	0.75	1.68	1.56
Median	8.00	8.00	8.00	7.50
Minimum	4.00	7.00	4.00	3.00
Maximum	9.00	9.00	9.00	9.00

Numbers in rows followed by different superscripts are significantly different ($P < 0.05$).

Table 3. Descriptive statistics for taste.

Product/Statistic	Control	10% Replacement	20% Replacement	30% Replacement
Mean	7.13[a]	7.63[a]	7.20[b]	6.83[c]
Standard Deviation	1.76	1.45	1.30	1.78
Median	7.00	8.00	7.00	7.00
Minimum	3.00	4.00	4.00	3.00
Maximum	9.00	9.00	9.00	9.00

Numbers in rows followed by different superscripts are significantly different ($P < 0.05$).

Taste is an important sensory attribute of any food. Intake of bread is often enhanced by taste [9]. The result as indicated in **Table 3** show a reduction in mean score of samples of bread with high proportions of cassava flour replacement. **Table 3** also shows that bread samples from 10% and 20% cassava flour replacement and pure and blend of wheat, flour, respectively, showed high sensory scores on taste than the sample with 30% cassava flour replacement. The taste of bread made from the 100% wheat flour was comparable to the bread made from the substitution levels of 20% cassava flour in statistical significance terms whist significantly different from the 10% and 30% cassava replacements.

Evidence from literature supported the fact that the loaf size and texture, colour of the crust and taste were the most undesirable attributes for bread baked with high cassava flour concentrations [10].

3.1.3. Aroma

Aroma is an important parameter of food [11]. "Good" aroma from food excites the taste buds, making the system ready to accept the product. "Poor" aroma may cause outright rejection of food before they are tasted. A good level of aroma intensity influences taste [8]. From the results of the sensory evaluation of the four products under study, the control product (all wheat flour) recorded the highest mean rating for aroma with mean value of 7.90, giving it a better preference for aroma over the other products. The product with 10% cassava flour replacement was rated second most preferred with respect to aroma with mean of 7.57, with the product replacement of 20% cassava flour pooling a mean rating of 7.13, whiles the product with 30% cassava flour replacement was rated last with 6.40 (**Table 4**). Even though all the products recorded mean ratings above the mid-point mark of 4.5, the results indicated that, the more the cassava flour, the less accepted the product as far as aroma is concerned.

3.1.4. Gumminess

Gumminess describes how much elasticity is felt in a product which is normally through splitting the product or tasting (chewing) the product. With the current products, the all wheat flour (control product) was noted with the highest level of gumminess pooling a mean rating of 4.80. The gumminess level of the 10% replacement product stood at 5.70. The 20% replacement was at 6.83 whiles the 30% replacement saw a significant high level mean rating at 7.60 (**Table 5**). Normally, the lower the gumminess, the better the product most especially, with bread and other flour products. At 95% confidence level, there were significant between all four bread samples with a positive correlation between the amount of cassava flour replacement and the level gumminess of the bread sample. The more the cassava flour replacement, the higher the level of gumminess.

The replacement of wheat flour with cassava flours decreased cohesiveness, and resilience in bread samples; however, it increased gumminess. The results of springiness (which indicates the percentage recovery of bread), and resilience (which express the ability or speed of material to return to its original shape after a stress) indicated that when the substitution level of cassava flours increased, the bread required more time to recover its shape.

A similar study by [12] indicates that gumminess increased with an increased amount of cassava flours in the blends. Furthermore, her results revealed that

Table 4. Descriptive statistics for aroma.

Product/Statistic	Control	10% Replacement	20% Replacement	30% Replacement
Mean	7.90^{a}	7.57^{b}	7.13^{c}	6.40^{d}
Standard Deviation	1.45	1.04	1.11	1.73
Median	8.00	8.00	7.00	7.00
Minimum	4.00	6.00	5.00	2.00
Maximum	9.00	9.00	9.00	9.00

Numbers in rows followed by different superscripts are significantly different ($P < 0.05$).

Table 5. Descriptive statistics for gumminess.

Product/Statistic	Control	10% Replacement	20% Replacement	30% Replacement
Mean	4.80^{a}	5.70^{b}	6.83^{c}	7.60^{b}
Standard Deviation	1.13	1.48	1.49	1.58
Median	8.00	7.00	7.00	7.00
Minimum	6.00	3.00	4.00	3.00
Maximum	9.00	9.00	9.00	9.00

Numbers in rows followed by different superscripts are significantly different ($P < 0.05$).

gumminess and chewiness values are highly dependent on hardness rather than on cohesiveness or springiness values and thereby increasing the gumminess level.

Taha also reported that since wheat flours contain gluten protein which by suitable development gives the bread it's unique and much desired texture; the inclusion of cassava flours dilutes wheat gluten, and consequently weakens its strength. The presence of starch in baking affects crumb characteristics [12].

3.1.5. Mouth-Feel

In **Table 6** is the descriptive characteristic of the mouth-feel nature of the products under study. The product with the 30% cassava flour replacement was rated the least as far as mouth-feel is concern with mean rating of 6.70. The 20% cassava flour replacement was rated at 7.30, whiles the 10% replacement was rated with a mean value of 7.80. The control product pooled a mean rating of 7.50. The products were rated in the order of 10%, control, 20% and 30%.

Similarly to a study by [13], which suggests that when the proportion of cassava flours increased in breads, the softness and mouth feel of bread scores decreased significantly, the mouth feel of the bread products understudy decreases significantly with 20% and 30% cassava flour replacements. From the results, there was not statistical significant difference in the mean value of the control product and the 10% cassava replacement. However, there was a significance difference in the mean ratings of the above mentioned product samples and the 20% and 30% cassava flour replacements.

3.1.6. Overall Acceptance

In **Table 7** is the descriptive statistics of the overall satisfaction panellists have with the entire product. The mean rating as indicated in **Table 7** suggest that, the product with the 10% cassava flour replacement was overall most preferred with mean rating as high as 8.37, followed by the control product 7.30, the 20% cassava flour replacement with 7.13, and finally the 30% cassava flour replacement with 6.97. It was noted that, there was significant difference in the overall acceptability of the 10% cassava flour replacement and the rest of the sample products. However, there was no significant difference in the control product (all wheat flour) and the 20% replacement.

Table 6. Descriptive statistics for mouth-feel.

Product/Statistic	Control	10% Replacement	20% Replacement	30% Replacement
Mean	7.50^{a}	7.80^{a}	7.30^{b}	6.70^{c}
Standard Deviation	0.90	1.37	1.37	1.66
Median	7.50	7.50	7.50	7.00
Minimum	6.00	5.00	5.00	2.00
Maximum	9.00	9.00	9.00	9.00

Numbers in rows followed by different superscripts are significantly different ($P < 0.05$).

Table 7. Descriptive statistics for overall acceptance.

Product/Statistic	Control	10% Replacement	20% Replacement	30% Replacement
Mean	7.30[a]	8.37[b]	7.13[a]	6.97[c]
Standard Deviation	1.32	1.38	1.51	1.90
Median	8.50	8.00	7.50	7.00
Minimum	3.00	4.00	3.00	2.00
Maximum	9.00	9.00	9.00	9.00

Numbers in rows followed by different superscripts are significantly different ($P < 0.05$).

The results on acceptability agreed with those reported in previous related studies where it was found out that substitution levels of cassava flour obtained from citric acid treated tubers influenced overall acceptance of bread and overall acceptability scores decreased with an increase in cassava flour supplementation level for wheat-cassava composite biscuit enriched with soy flour [14] [15].

High Quality Cassava Flour has potential to succeed for use in bakery products as partial substitute for wheat flour but commercial production and consumption of bread made from composite flour will depend on their price and local acceptance of bread characteristics. Considerable promotion is probably required to drive market demand for composite wheat/cassava products [16].

As the substitution level increased in wheat/cassava bread, loaf specific volume decreased and density and hardness increased. Breads baked with 10% and 20% cassava flour were accepted by the sensory panel in terms of appearance, colour, mouth-feel, taste and texture. These results showed that High Quality Cassava Flour has potential to replace part of the wheat flour in bakery products since there is a wide acceptance among consumers [8].

3.2. Proximate Composition of Bread

From **Table 8**, it can be seen that the moisture content of the samples ranged from 18.10% to 11.7%. At the baking temperature (which is normally greater than 100˚C) the moisture content of the raw samples must have been greatly reduced. However, different food materials have different capacity for absorbing/retaining moisture which may exist as occluded or absorbed water. As a result, it can be deduced that even at the high baking temperature, some moisture will be found in the samples as observed during the study.

Crude protein content of whole wheat and composite bread were 11.1.0%, 10.9.0%, 10.08%, and 9.77%, for samples A, B, C, and D respectively. The protein contents decreased as the amount cassava flour decreased as the amount cassavas flour increases. Generally, the protein content of the samples were relatively low because wheat and cassavas are poor sources of protein [17] [18]. Fat extract, were found to be low in value in all the samples and control, 100% (1.73%), 90% (2.31%), 80% (1.47%), 70% 1.05%) respectively, these values were comparable to values reported by Ekpo *et al.*, (in press) for some bread sold in Akwa Ibom State. Generally, the fat content of the bread decreased in the order

Table 8. Analysis of proximate composition of bread.

Parameter	A Control	B 10%	C 20%	D 30%
Moisture	17.5 ± 0.14[a]	18.2 ± 0.38[a]	20.0 ± 0.7[b]	18.62.4[a]
Iron	1.35 ± 0.62[a]	1.39 ± 0.33[a]	1.70 ± 0.52[b]	1.79 ± 0.15[b]
Protein	11.2 ± 1.0[a]	10.9 ± 0.9[a]	10.08 ± 0.91[a]	9.37 ± 1.3[a]
Fat	1.73 ± 0.32[b]	2.31 ± 0.21[c]	1.47 ± 0.37[a]	1.05 ± 0.19[b]
Fibre	1.86 ± 0.11[c]	0.43 ± 0.08[a]	0.80 ± 0.01[c]	0.66 ± 0.00[b]
Carbohydrate	66.4 ± 1.35[a]	66.8 ± 2.11[a]	65.9 ± 1.03[a]	68.0 ± 0.09[a]
Energy (KG/100g)	44.8 + 15.6 + 265.6	43.6 + 20.8 + 267.2	40.4 + 13.3 + 263	37.5 + 76.7 + 272
	326.0[b]	**331.6[c]**	**317[a]**	**386.2[d]**

of supplementation. This shows that the composition of the bread samples may have had a negative effect fat content. However, there was no significant difference between the fat contents of all-wheat flour bread and the composite flour bread.

Fibre showed an increase from all-wheat-flour to 10% flour 100% (1.86%), 90% (0.43%), 80% (0.80%), 70% (0.66%) respectively. The fibre content of the composite bread samples were higher than those of 100% wheat bread and tend to increased as the level of supplementation increases.

The nutritional roles of fibre have not been fully established but it is known that fibre contributes to the health of the gastrointestinal system and metabolic system in man. Because crude fibre consists of cellulose and lignin, its estimation affords an index for evaluation of dietary fibre whose efficiency has been implicated in a variety of gastrointestinal disorder. By increasing intestinal mobility, fibre causes increased transit time for bile salt derivatives as deoxycholate, white are effective chemical carcinogen, hence reducing incidence of carcinoma of the colon.

The carbohydrate of the bread samples ranged from 66.4% to 68.0% with higher values obtained in composite flour bread compared to the 100% wheat bread. This observation may be attributed to the high content of carbohydrate in cassava. According to [19], of all the solid nutrients in roots and tubers, carbohydrate predominates. Carbohydrate supplies quick source of metabolisable energy and assists in fat metabolism.

The ash content of the composite bread samples were 100% (1.35%); 90% (1.39%); 80% (1.70%) and 70% (1.79%) respectively. Generally the ash content of composite breads increases the level of supplementation increases implying that the inorganic nutrients in the composite breads are richer than that of wheat bread.

4. Conclusions

From the results, it can be concluded that cassava flour substitution mostly up to 10% significantly affects the sensory characteristics and overall acceptability of bread made from wheat-cassava flour blends. Increased substitution level of cassava flour correspondingly reduced protein and fat contents in the breads and increased the gumminess. Generally, index to volume (Mean) scores were higher in a 10% substitution level in cassava flour that is recommended for acceptable sensory attributes in breads made from wheat-cassava flour blends.

Although the proximate composition of the composite breads was slightly different from that of 100% wheat bread, it has been found that bread baked with 10% and 20% composite flour was not so significantly different in most sensory attributes, acceptability from the control. Bread baked from 30% cassava flour showed low mean scores to all the attributes but for gumminess. There was a tendency for bread baked with 10% and 20% composite flour to be rated higher than the control especially in aroma, colour, flavour, general and acceptability which will lead to consumers' preference to buy. These results showed that the 10% and 20% wheat/cassava composite flour bread recipe could be a viable alternative to achieve the desired economic, food security and health.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

[1] Dziedzoave, N., Graffham, A.J. and Boateng, E.O. (2006) Training Manual for the Production of Cassava-Based Bakery Production (Vol. 25). Food Research Institute (FRI), Accra.

[2] Oduro, I., Ellis, W.O., Dziedzoave, N.T. and Nimako-Yeboah, K. (2000) Quality of Gari from Selected Processing Zones in Ghana. *Food Control Journal*, **11**, 297-303. https://doi.org/10.1016/S0956-7135(99)00106-1

[3] FAO (2004) Business Opportunities for the Use of Cassava. *Proceedings of the Validation Forum on the Global Cassava Development Strategy*, *Global Cassava Market Study*, Rome, 26-28 April 2000, 1015.

[4] Falade, K. and Akingbala, J. (2010) Utilization of Cassava for Food. *Food Reviews International*, **27**, 51-83. https://doi.org/10.1080/87559129.2010.518296

[5] CSIR-FRI (2009) Training Manual for the Production of High Quality Cassava Flour (HQCF). Accra.

[6] Brima, G., Okechukwu, R., Abass, A.F., Maziya-Dixon, B., Sanni, L., Osei-Sarfoh, A., *et al.* (2012) Producing Gari from Cassava, an Illustrated Guide for Smallholder Cassava Processes. http://www.iita.org

[7] Dendy, D. (2013) Review of Composite Flour Technology in the Context of Tanzania. National Resources Institute, Chatham.

[8] Eddy, N., Udofia, P. and Eyo, D. (2007) Sensory Evaluation of Wheat/Cassava Composite Bread and Effect of Label Information on Acceptance and Preference. *African Journal of Biotechnology*, **6**, 2415-2418. https://doi.org/10.5897/AJB2007.000-2379

[9] Sim, J. and Tam, N. (2001) Eating Qualities of Muffins Prepared with 10% and 30% Soy Flour. *Journal of Nutrition in Recipe & Menu Development*, **3**, 25-34. https://doi.org/10.1300/J071v03n02_03

[10] Aboaba, O. and Obakpolor, E. (2010) The Leavening Ability of Baker's Yeast on Dough Prepared with Composite Flour (Wheat/Cassava) *African Journal of Food Science*, **4**, 325-329.

[11] Iwe, M.O. (2002) Handbook of Sensory Methods and Analysis. PROJOINT Communications Services Ltd., Enugu.

[12] Taha, A. (2000) The Role of Sorghum Flour Starches (Amylose/Amylopectin) in Composite Bread Quality. University of Khartoum, Khartoum.

[13] Abdelghafor, R.F., Mustafa, A.I., Ibrahim, A.M. and Krishnan, P.G. (2011) Quality of Bread from Composite Flour of Sorghum and Hard White Winter Wheat. *Advance Journal of Food Science and Technology*, **3**, 9-15.

[14] Owuamanam, C.I. (2007) Quality of Bread from Wheat/Cassava Composite as Affected by Strength and Steeping Duration of Cassava in Citric Acid. *Nature and Science*, **5**, 2428.

[15] Oluwamukoni, M.O., Oluwalana, I.B. and Akinbowale, O.F. (2011) Physicochemical and Sensory Properties of Wheat-Cassava Composite Biscuit Enriched with Soy Flour. *African Journal of Food Science*, **5**, 5056.

[16] Estelle, E. (2013) Flour from Three Local Varieties of Cassava (Manihot Esculenta Crantz): Physico-Chemical Properties, Bread Making Quality and Sensory Evaluation. Swedish University of Agricultural Sciences, Uppsala.

[17] Oyenuga, V.A. (1992) Nigerian Food and Feeding Stuffs. Ibadan University Press, Ibadan.

[18] Okaka, J.C., Akobundu, E.N.T. and Okaka, A.N. (2002) Human Nutrition: An Integrated Approach. 2nd Edition, OCJANCO Academic Publishers, Enugu, 312-320.

[19] Enwere, N.J. (1998) Foods of Plant Origin. Afro-Obis Publ. Ltd., Nsukka, 301.