Direct RESEARCH JOURNALS

Effect of Cassava (*Manihot Esculenta* Crantz) variety, drying process and blending ratio on the proximate composition and sensory properties of Cassava-Wheat composite bread

Direct Research Journal of Agriculture and Food Science (DRJAFS) Vol.3 (2), pp. 38-47, February 2015
Available online at directresearchpublisher.org/drjafs
ISSN 2354-4147 ©2015 Direct Research Journals Publisher

Research Paper

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ABSTRACT

The use of composite cassava-wheat flour for commercial bread making purposes and consumption of composite cassava-wheat bread are relatively new in Ethiopia. This experiment was conducted to explore the effects of cassava variety, drying methods and blending ratio on chemical compositions and sensory properties of cassava-wheat composite bread. Two levels of cassava varieties (Qulle and Kello), two levels of drying methods (sun and oven) and three levels of blending ratio (11.12g, 25.00 g and 42.90 g of cassava in 100 g of control wheat flour) were used and the treatments were factorial arranged in complete randomized design with three replications. Blending with Qulle and Kello varieties had reduced crude protein content to 9.18 and 8.84 %, respectively as compared to the protein content (10.05 %) in the control (100% wheat bread). Similarly, the crude fat dropped to 1.18 -and 1.12 % from 2.33%, the crude fiber increased to 2.05 and 2.03 % from 1.17 %, the carbohydrate (%) increased to 80.13 and 81.10 from 77.33, the ash increased to 2.21 and 2.10 % relative to 1.82 % in wheat bread. No significant (P>0.05) differences were detected in proximate compositions attributed to the two drying methods. With increase in blending ratio the carbohydrate, the crude fiber and the ash contents increased whereas the protein content decreased significantly (P<0.05). No significant (P>0.05) differences were observed in overall acceptability of the composite breads due to varieties and drying methods. However, as the blending ratio increased the overall acceptability dropped significantly (P<0.05). It could be concluded that the substitution of cassava flour with wheat flour in bread making with substitution level up to 25 g in 100g wheat flour did not adversely affect the quality properties of the bread and produce bread comparable to that produced from wheat flour in the proximate compositions and sensory acceptability. Further studies are required to investigate the impacts of anti-nutrients and storage period on cassava-wheat composite bread.

Key words: Blending, cassava, drying, composite bread, proximate and sensory acceptability.

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Accepted 26 December, 2014

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is the major food crop produced in southern Ethiopia with maize and wheat being the first one at southern part of the country. A major constraint to cassava utilization is the rapid microbial degradation after harvest. Cassava roots have a shelf life of only 24-48 hr after harvest (Wenham, 1995). One way to extend the shelf life of cassava is to prepare a dry product such as flour. In Ethiopia the main common cassava flour products prepared for human consumption are sun dried. Traditionally, cassava flour can be produced from washed or peeled roots that are chipped, or sliced, then sun-dried on trays, and finally milled into flour (Westby, 2002). It provides energy to consumers due to the large amount of carbohydrates in its roots. Its advantages over other crops particularly; in many of the developing world is its outstanding ecological adaptation, low labor requirement, ease of cultivation, high yields, drought tolerant crops and successfully grown on marginal soils, where many other crops do not grow well (O'Brien *et al*., 1992).

In Ethiopia, this crop has been cultivated in the southern and southwestern regions for decades as an alternative food insecurity crop (Taye, 2000; Desse and Taye, 2001). In the southern Ethiopia, particularly in Amaro-Kello area, cassava is almost used as a staple food. In Wolayta and Sidama Zone, cassava roots are widely consumed after washing and boiling or in the form of bread or "*injera*"(Ethiopia staple food) after mixing its flour with that of some cereal crops such as maize (*Zea mays*), wheat *(Triticum aestivum* L.), sorghum (*Sorghum bicolor*), or *tef* (*Eragrostis tef*) (Taye, 1994). Processing methods, storage experience and modes of consumption are not yet documented in Ethiopia, unlike most of cassava producing and consuming African countries. Cassava is one of the underutilized root crops in the country. The crop has been used in south western areas of Ethiopia mainly to tackle seasonal food shortage. Currently, some cassava varieties are being promoted in food insecure northern areas of Ethiopia.

Cassava varieties have been classified as bitter or sweet depending on their cyanogenic glucoside contents. The major drawbacks of the cassava crop are the low tuber protein content, rapid tuber perishability following harvest, and high content of the cyanogenic glucosides which is the main toxic substance in cassava roots. The bitter variety of cassava must be processed (Therberger *et al.,* 1985) because it has higher cyanide levels than the FAO/WHO (1991) recommendations, which is less than10 mg cyanide equivalents/kg on dry weight basis, to prevent acute toxicity in humans. Variety plays a very important role in the production of diversified food products due to inherent characteristics which vary from one cassava to the other (Zhang *et al*., 2010). Processing of cassava roots into dry form reduces the moisture content; converts it into more durable and stable product with less volume, which makes it more transportable. Processing is also necessary to improve palatability, eliminate or reduce the level of cassava cyanide contents (Cardoso *et al.,* 2005). Drying can be carried out using solar radiation (sun drying) or oven drying (artificial drying) depending on economic viability. Bread and other wheat containing baked products are widely accepted and consumed throughout the world. Bread is an important staple food, the consumption of which is steady increasing in developing country like Ethiopia (Edema *et al*., 2005). Due to the high cost and demand of wheat flour, efforts have been made to promote the use of composite flours in which flour from locally grown crops replace a portion of wheat flour for use in bread, thereby decreasing the demand for imported wheat and producing protein enriched bread (Giami *et al*., 2004).

According to Hoffer (2007) the composite bread can be made by substituting 10, 20 and 30% cassava flour for wheat flour. Cassava flour is a good substitute for wheat flour in bread making (Essien, 2006). Most developing countries including Ethiopia are largest importer of American red winter wheat (Edema *et al*., 2005). This implies that these countries are dependent on foreign countries for their bread production. Therefore the use of cassava flour for production of baked foods if feasible would help to lower the dependency of developing nations on imported wheat. The present study was therefore, mainly envisaged to study the effect of cassava varieties, drying methods and blending ratio on the proximate compositions and sensory acceptability of cassava-wheat composite bread.

MATERIALS AND METHODS

Experimental site

The experiment was conducted in laboratories of Food Science and Postharvest Technology at Hawassa and Haramaya Universities, Ethiopia.

Materials preparation

Wheat flour was purchased from factory of Hawassa Flour Share Company (Hawassa, Ethiopia). Qulle and Kello sweet varieties of cassava tuber were sourced from the Hawassa Agricultural Research center (HARC). Cassava was processed into cassava flour using the standard method reported by IITA/UNICEF (1990).During the cassava chips drying period the area ambient temperature was 27.9 °C, while the relative humidity fluctuated between 65-100 %. After harvesting the tubers were processed immediately within a day on arrival at laboratory.

The roots were sorted and washed with tap water to remove soil and then peeled manually with knife, sliced into chips by slicer machine. The sliced cassava chips were soaked in water for 24 hours to detoxify (Diop, 1998).

The chips were sun dried and oven dried at 60 ^{o}C for 72 hours and 32 hours respectively. The dried chips were finely milled into flour using commercial mill and the resulting flour was sieved to pass through 250 μm aperture then packed in polyethylene plastic bags and finally stored at room temperature until required for the experiment.

Experimental treatments and design

The experiment was conducted using three level of blending ratios [0:100 g as control, 11.12 g: 100 g (B1), 25.00 g: 100 g (B2) and 42.90 g: 100 g (B3)], two sweet cassava varieties (Qulle and Kello) and two drying methods (sun and oven) and the treatments were factorial arranged in completely randomize design (CRD) with three replications.

Bread making

Bread were baked using straight-dough method as described in the AACC (2000) method No. 10-10B. The composite of cassava-wheat flours dough were prepared and baked according to the method specified by the National Root Crop Research Institute, Umudike, (IITA, 2005). Wheat flour and cassava-wheat blend flour 300 g, 18 g sucrose, 4.5 g sodium chloride (NaCl), 6 g dry baker's yeast and the optimum amount of distilled water calculated from water absorption were used. The baking time and temperature used were 25 min and 220 ℃ respectively (Naofumi *et al.,* 2007).

Proximate analysis and sensory evaluation of composite bread

Breads produced from the cassava-wheat composite flours were subjected to proximate analysis and sensory evaluation. The percentage of moisture, ash, crude fat, crude protein and crude fiber of the accepted composite breads was carried out using recommended standard methods (AOAC, 2002). Nitrogen to protein conversion factor of 6.25 was used. Carbohydrate was calculated by difference. Coded samples of the composite breads were served to fifty trained member (30 male and 20 female) panelists were selected from the Food Science and Postharvest Technology department staff and graduate students positioned in partitioned booths. The sensory attributes such as color, texture, flavor, taste, appearance and overall acceptability of composite breads were evaluated. These attributes were rated on a 5-point hedonic score scale as: 1 (extremely dislike), 2 (dislike moderately); 3 (neither like nor dislike), 4 (like moderately) to 5 (extremely like). Samples receiving an overall quality score of ≥ 3 were considered acceptable (Iwe, 2002).

Statistical analysis

The experiment was carried out using a completely randomized design (CRD) in factorial arrangement method as outlined by Steel and Torrie (1980). Three replicates per treatment were evaluated for the effect of cassava variety, drying method and blending ratio on the physic-chemical composition and consumer acceptance of cassava-wheat composite bread. The data were analyzed using an Analysis of Variance (ANOVA). Where possible, mean comparisons were made using the Duncan's multiple range tests (DMRT) at $p \leq 0.05$. Statistical analysis was carried out using the SAS (Version 9.0) system.

RESULTS AND DISCUSSIONS

The main effects of varieties, drying methods and blending ratios on proximate compositions of Cassava-Wheat composite breads

Proximate compositions and total energy of cassava-wheat composite breads were analyzed and the results are presented in Table 1.

Moisture

The moisture content of the composite breads was significantly affected ($p<0.05$) by blending ratios. The values were found to be 5.34%, 5.02% and 4.75 %, for 11.12 g, 25.00 g and 42.90 g blending ratio of cassava flour, respectively (Table 1). Moisture content of control wheat bread (6.85%) was significantly ($p<0.05$) higher when compared with those of the composite bread samples. The moisture content of samples decreased as level of supplementation of cassava flour increased. At the highest baking temperature the moisture content of the bread samples must have been greatly reduced. However, different food materials have different capacity for absorbing moisture which may exist as absorbed water. As a result, it cannot be deduced that even at high baking temperature (Eddy, 2004). There was significant difference ($P<0.05$) in moisture content of composite breads due to cassava varieties (Table 1). The highest moisture content (5.25 %) was observed for Qulle variety cassava flour containing bread whereas the lowest (4.82 %) was for Kello variety blended bread. The moisture contents of the composite breads are significantly ($p<0.05$) lower than that of the wheat bread. The lower moisture content recorded for the composite breads is an indication of longer shelf life for the product which agrees with the finding of Olaoye *et al.,* (2007). It is known low moisture confers longer shelf life to the food products thereby microbial proliferation is minimum at the moisture content recorded for this study is in agreement with the result obtained for oven dried cassava flour (Nwabanne, 2009).

Ash

The ash content of the control sample was 1.82 %, for

Table 1. The main effects blending ratio, varieties and drying methods on proximate composition of cassava–wheat composited breads.

Treatments	Moisture (%)	Ash (%)	Fat (%)	Fiber (%)	Protein (%)	CHO (%)	Energy (kcal/100g)
Main effects of blending ratio							
DVB1	5.34±0.22[b]	2.02±0.10[c]	1.19±0.10[b]	1.95±0.04[c]	9.74±0.19[b]	79.78±0.53[c]	368.59±1.09[b]
DVB2	5.02±0.38[c]	2.17±0.12[b]	1.17±0.16[b]	2.05±0.03[b]	9.23±0.30[c]	80.34±0.68[b]	368.91±2.03[b]
DVB3	4.75±0.28[d]	2.26±0.05[a]	1.09±0.09[b]	2.12±0.01[a]	8.05±0.21[d]	81.73±0.58[a]	368.99±1.15[b]
Cont.	6.85±0.01[a]	1.82±0.02[d]	2.33±0.18[a]	1.17±0.04[d]	10.50±0.12[a]	77.33±0.21[d]	372.27±1.01[a]
Cv (%)	2.79	4.33	9.92	1.69	2.57	1.73	1.29
Main effects of cassava varieties							
BDKv	4.82±0.37[c]	2.10±0.15[b]	1.12±0.14[b]	2.03±0.09[a]	8.84±0.75[c]	81.10±0.92[a]	369.79±1.45[b]
BDQv	5.25±0.25[b]	2.21±0.10[a]	1.18±0.10[b]	2.05±0.06[a]	9.18±0.74[b]	80.13±0.89[b]	367.86±0.54[c]
Cont.	6.85±0.01[a]	1.82±0.02[c]	2.33±0.18[a]	1.17±0.04[b]	10.50±0.12[a]	77.33±0.21[c]	372.27±1.01[a]
Cv (%)	4.59	5.78	10.11	3.93	7.92	2.35	1.24
Main effects of drying methods							
BVOv	5.09±0.33[b]	2.21±0.12[a]	1.17±0.09[b]	2.05±0.09[a]	9.04±0.77[b]	80.44±0.97[b]	368.48±0.99[b]
BVSu	4.98±0.43[b]	2.09±0.13[b]	1.12±0.15[b]	2.04±0.06[a]	8.97±0.75[b]	80.79±1.06[a]	369.18±1.77[b]
Cont.	6.85±0.01[a]	1.82±0.02[c]	2.33±0.18[a]	1.17±0.04[b]	10.50±0.12[a]	77.33±0.21[c]	372.27±1.01[a]
Cv (%)	3.02	5.73	10.21	3.95	8.13	2.55	1.27

Results are mean values of triplicate determination (dwb) ± standard deviation. Mean values with the same letters in the same column are not significantly different (P>0.05). Cont. = Control sample (100 g wheat flour bread), BVOv = Oven dried cassava flours blended breads, BVSu = Sun dried cassava flours blended breads, DVB1= 11.12 g sun and oven dried cassava flours mixed with 100 g WF, DVB2= 25 g sun and oven dried cassava flours mixed with 100 g WF, DVB3= 42.9 g sun and oven dried cassava flours mixed with 100 g WF, BDKv = Kello variety processed by both drying methods blended bread, BDQv = Qulle variety processed by both drying methods blended bread, CV= coefficient variance.

11.12 g cassava flour. It was 2.02 %, for 25g cassava flour 2.17 % and for the 42.5g cassava flour 2.26 %. Generally, the ash content of composite bread samples increased as the level of supplementation increased implying that cassava flours had positively impacted on inorganic nutrients in the composite bread. There was a significant difference (P<0.05) among blending ratios for ash content of cassava flours composite bread samples (Table 1).

There was a significant difference (P<0.05) in ash content of composite bread samples due to variety (Table 1). Highest ash content (2.21 %) of cassava flour composite breads was observed due to Qulle variety followed by Kello variety (2.10 %). The percentage of ash determined in this study for both cassava varieties was found to be greater than that of composite bread samples specified by the standard organization of Nigeria which is not more than 1.5 percent ash content (Sanni *et al*., 2005). There was a significant effect (P<0.05) on the ash content of composite bread due to drying methods. The ash content of composite breads of oven and sun dried cassava flours were 2.21 % and 2.09 %, respectively (Table 1). The highest ash was observed for oven dried flours blended bread and the lowest was for control wheat bread sample (1.82 %).

Crude fat

The crude fat of composite bread samples were 1.17 % for 11.12 g cassava flour, 1.19 % for 25g cassava flour 1.19 % and 1.09 % for 42.9g cassava flour. The wheat bread sample had higher crude fat content than those of the composite bread samples (2.33%). The low fat content of the composite breads could be due to the presence of fat in the cassava flour at lower amount (0.47 %) than in wheat flour (2 %) (Nassar *et al.,* 2008).

The low content of fat will enhance the storage life of the food products due to the lowered chance of rancid flavor development. Blending ratios showed no significant (P>0.05) effect on crude fat content among the composite bread samples (Table 1).

There was no a significant difference (P>0.05) in the crude fat content among the composite bread samples due to cassava variety and drying methods (Table 1). However, there was significant difference between cassava flour composite bread and control wheat bread sample.

Crude fiber

There was a significant difference (P<0.05) in crude fiber content of composite breads due to various blending ratios (Table 1). The crude fiber of 100 g wheat flour was 1.17 %; for 11.12 g wheat flour it was 1.95 %; for 25 g cassava flour it was 2.05 % and for 42.90 g cassava flour it was 2.12 %. The crude fiber content of the composite breads increased with increase in substitution of cassava flour from 1.17 % in the control sample to 1.95 %, 2.05 % and 2.12 % of the samples of 11.12 g, 25.00 g and 42.90 g cassava flour containing breads, respectively. The increase might have been due to the fiber content in the cassava flour which increased with increase in its level in the composite flour.

According to previous research wheat bread may contain 0.6-1.9 % insoluble fiber and 0.1-2.8 % soluble fiber (Prosky *et al*., 1994) making the total content of fiber up to 0.7 and 4.7 %. The crude fiber in the composite bread is greater than 1.5 % maximum allowable fiber content of bread flour as stated by Omole (1977) and except for 10 % blending the rest are also higher than 2.0 % recommended by Nigerian raw materials research and development council (RMRDC., 2004).

There was a significant difference (P<0.05) associated with cassava variety in crude fiber content of composite bread samples (Table 1). Highest crude fiber content was observed due to Qulle variety (2.05%) followed by Kello variety (2.03 %) of cassava flour containing breads. Drying methods had no a significant effect (P>0.05) on crude fiber content of composite bread samples.

Crude protein

Blending ratio had a significant effect (p<0.05) on the crude protein content of composite breads, due to blending ratios which led to have 9.74% for 11.12 g cassava flour, 9.23 % for 25 g cassava flour and 8.05% for 42.9 g cassava flour, when using 100 g wheat flour having 10.50 % protein (Table 1). The protein contents of the composite flour breads are significantly lower than that of the control sample. Increase in the blending levels of cassava flour resulted in decrease in the protein content progressively.

This is because of the low protein content of the cassava flour (1-2 %) which has diluted the protein content of the wheat flour. The protein content of all the composite breads can be regarded low because wheat and cassavas are poor sources of protein compared with legumes (Oyenuga, 1972). According to Njintang *et al*., (2007), as a result of the low level of proteins in the cassava flour, it's incorporation into wheat flour is expected to reduce the protein content of the composite bread and thus has a significant effect (P<0.05) on the rheology of dough made from such composites flours.

The crude protein content of the composite flour breads made from Kello and Qulle varieties cassava had a significant difference (p<0.05) with values of 8.84 % and 9.18 %, respectively. On the other hand, the crude protein content of oven and sun dried cassava flour composite breads had no significant effect (p>0.05) with values of 9.04 % and 8.97 %, respectively.

Carbohydrate

The blending ratios had a significant effect (P<0.05) on carbohydrate content of the composite bread samples (Table 1). Increase in the blending levels of cassava flour resulted in an increased in the carbohydrate content progressively from 77.33% of 100 g wheat flour to 79.78 %, 80.34 % and 81.73 % of breads with 25.00 g and 42.90 g and 42.9 g cassava flour composites, respectively. This is attributed to the high content of carbohydrate in cassava flours. The significant difference (p<0.05) were observed between the control wheat bread and all the composite flour breads. According to Enwere (1998) carbohydrates are dominant all the solid nutrients in root and tubers. Findings in this study suggest that bread could serve as a source of energy for the metabolic process in the mammalian body (Bennett and Nozzolillo, 1987).

Significant difference (P<0.05) were noted in carbohydrate content of composite bread samples due to cassava varieties (Table 1). The highest carbohydrate content (81.10 %) was observed for Kello variety cassava flour containing breads followed by Qulle variety (80.13 %). Drying methods of cassava flour had also a significant (P<0.05) effect on the carbohydrate content of composite bread samples. The highest carbohydrate content (80.79 %) was observed for sun dried cassava flour containing bread and the lowest (80.44 %) was for oven dried sample.

Energy

Various level of blending ratios had no significant impact (P<0.05) on the total energy content of composite flour bread samples (Table 1). The energy content observed in wheat bread were 372.27kcal/100g) followed by 368.59 kcal/100g, 368.99 kcal/100g and 368.91 kcal/100g for substitution of 25.00 g and 42.90 g cassava flour, respectively. Similarly, drying methods had no significant effect (P>0.05) on energy content among composite bread samples. Conversely, cassava varieties were showed significant difference (P>0.05) in energy content of composite flour breads (Table 1). The highest energy content (372.27 kcal/100g) was observed for the control wheat bread followed by Qulle (367.86 kcal/100g) and Kello (369.79 kcal/100g) varieties cassava flour composite breads. The energy content of both cassava varieties are less than the value presented in food

Table 2. The interaction effect of varieties, drying method and blending ratio on proximate composition of cassava-wheat composited bread.

Treatments	Moisture (%)	Ash (%)	Fat (%)	Fiber (%)	Protein (%)	CHO (%)	Energy (Kcal/100g)
OB1Kv	5.24±0.07^{cd}	1.99±0.01^{h}	1.13±0.01^{b}	1.88±0.02^{f}	9.59±0.07^{c}	80.17±0.15^{de}	369.24±0.33^{cde}
OB2Kv	5.03±0.48^{de}	2.23±0.01^{d}	1.18±0.11^{b}	2.11±0.00^{b}	8.86±0.10^{e}	80.60±0.69^{d}	368.45±1.52^{def}
OB3Kv	4.64±0.29^{f}	2.29±0.00^{bc}	1.11±0.04^{b}	2.12±0.01^{ab}	8.01±0.10^{g}	81.83±0.42^{b}	369.36±1.10^{cde}
SB1Kv	5.07±0.02^{de}	1.88±0.01^{i}	1.09±0.01^{b}	1.96±0.00^{e}	9.62±0.03^{c}	80.37±0.01^{de}	369.78±0.15^{cd}
SB2Kv	4.53±0.11^{f}	2.00±0.03^{h}	1.19±0.34^{b}	2.02±0.00^{d}	9.16±0.17^{d}	81.10±0.38^{c}	371.74±2.14^{ab}
SB3Kv	4.42±0.01^{f}	2.18±0.00^{e}	1.01±0.09^{b}	2.11±0.00^{b}	7.77±0.17^{h}	82.51±0.26^{a}	370.19±0.45^{bc}
OB1Qv	5.44±0.02^{bc}	2.13±0.01^{f}	1.23±0.18^{b}	1.98±0.00^{e}	10.00±0.17^{b}	79.22±0.08^{g}	367.90±0.84^{ef}
OB2Qv	5.20±0.06^{cde}	2.31±0.01^{ab}	1.24±0.06^{b}	2.05±0.00^{c}	9.59±0.02^{c}	79.610.04^{fg}	367.98±0.56^{ef}
OB3Qv	5.01±0.12^{de}	2.32±0.01^{a}	1.15±0.02^{b}	2.14±0.00^{a}	8.19±0.05^{fg}	81.20±0.17^{c}	367.96±0.57^{ef}
SB1Qv	5.62±0.07^{b}	2.09±0.01^{g}	1.22±0.00^{b}	1.98±0.00^{e}	9.73±0.07^{c}	79.36±0.14^{g}	367.36±0.28^{f}
SB2Qv	5.32±0.01^{cd}	2.13±0.01^{f}	1.15±0.02^{b}	2.04±0.00^{cd}	9.32±0.21^{d}	80.05±0.20^{ef}	367.79±0.18^{ef}
SB3Qv	4.92±0.01^{de}	2.27±0.01^{c}	1.09±0.13^{b}	2.12±0.00^{ab}	8.24±0.08^{f}	81.36±0.08^{bc}	368.19±0.65d^{ef}
Cont.	6.85±0.01^{a}	1.82±0.02^{j}	2.33±±0.18^{a}	1.17±0.04^{g}	10.50±0.12^{a}	77.33±0.21^{h}	372.27±1.01^{a}
Mean	5.17	2.13	1.24	1.98	9.12	80.36	369.09
Cv (%)	3.83	0.58	10.53	0.67	1.30	0.30	1.12

Values with the same letters in the same column are not significantly different (p>0.05) (dwb). Cont. = control (100 g wheat flour bread), (OB1Kv, OB2Kv and OB3Kv) = Breads from 11.12 g, 25.00 g and 42.90 g oven dried Kello variety cassava flour blended with 100g wheat flour, respectively, (OB1Qv, OB2Qv and OB3Qv) = Breads from 11.12 g, 25.00 g and 42.9 0 g oven dried Qulle variety cassava flour blended with 100g wheat flour, respectively, (SB1Kv, SB2Kv and SB3Kv) = Breads from 11.12 g, 25.00 g and 42.90 g sun dried Kello variety cassava flour blended with 100g wheat flour, respectively, (SB1Qv, SB2Qv and SB3Qv) = Breads from 11.12 g, 25g and 42.90 g sun dried Qulle variety cassava flour blended with 100g wheat flour, respectively CV= Coefficient variance.

composition Table by Bradbury and Holloway, (1988) which is 580 kcal /100g.

Interaction effect of variety, drying methods and blending ratio on proximate composition of Cassava-Wheat composite bread

Table 2 presents data showing the effects of the variety, drying methods and blending ratio combination on the proximate compositions of the composite breads. Ash content of composite breads had significant differences (p>0.05) due to the interaction of variety, drying methods and blending ratio. The highest ash contents (2.31 and 2.32 %) was observed for OB2Qv and OB3Qv samples, respectively whereas the lowest (1.88 %) was for 11.12 g sun dried Kello variety (SB1Kv) cassava flour composite breads. The ash content of wheat bread (1.82 %) was significantly lower than those of the composite breads. The ash content of composite bread increases as the level of cassava flour supplementation increases implying that the inorganic nutrients in the composite bread is richer than that of wheat bread. The ash content of cassava-wheat flour bread by Olaoye *et al.,* (2007) were observed to increase with an increase in the percentage of cassava flour. The percentage of ash determined in this study for both cassava varieties was found to be greater than that of composite bread samples specified by the standard organization of Nigeria which is not more than 1.5 percent ash content (Sanni *et al*., 2005).

Interaction of these three factors had resulted in crude fat content varying from 1.01 to 1.24 % with no significant difference (p>0.05) among them. However, their fat contents were significantly lower than that of the control sample (2.33 %). Conversely, the significant difference (p<0.05) was observed in fiber content of composite breads due to the interaction of these three factors. The highest fiber contents (2.13 and 2.14 %) was observed for SB3Qv and OB3Qv samples, respectively and the lowest (1.88 %) was for 11.12 g oven dried Kello variety (OB1Kv) cassava flour composite breads. The crude fiber content of wheat bread (1.17 %) was significantly lower than those of the composite breads. This is due to the high content of fiber in cassava flour. An increased in the crude fiber content of composite bread was reported by Nassar *et al*., (2008) in blending of cassava flour with wheat flour. The crude fiber in the composite bread is greater than 1.5 % maximum allowable fiber content of bread flour as stated by Omole (1977) and except for 10 % blending the rest are also higher than 2.0 %

recommended by Nigerian raw materials research and development council (RMRDC., 2004).

The combination of variety, drying methods and blending ratio had resulted in significant differences (p<.0.05) in crude protein contents of composite breads. The highest crude protein content (10.00%) was registered for 11.12 g oven dried Qulle variety cassava flour composite breads (OB1Qv) and the lowest value (7.77 %) was for 42.90 g sun dried Kello variety cassava flour composite bread (SB3Kv). The crude protein content of cassava-wheat composite breads was significantly lower than that of control wheat bread (10.50 %). This is because of the low protein content of the cassava flour (1-2 %) which has diluted the protein content of the wheat flour. The protein content of all the composite breads can be regarded low because wheat and cassava are poor sources of protein compared with legumes (Oyenuga, 1972). Statistically higher carbohydrate contents (82.51 %) was recorded for 42.90 g sun dried Kello variety cassava flour composite bread (SB3Kv) whereas the lowest (79.22 %) was for 11.12 g oven dried Qulle variety cassava flour composite bread (OB1Qv) due to the interaction effects of variety, drying methods and blending ratio.

The carbohydrate content of the composite bread samples were significantly higher than that of 100 g wheat bread (77.33 %) and tend to increased as the level of cassava flour substitution increases. This is may be due to the carbohydrate content in the cassava flour increased with increase in its level in the composite bread. These carbohydrate values presented were consistent with the range of 80% to 90% as reported by Montagnac *et al*. (2009).

The energy content of composite breads was not affected by the interaction effects of variety, drying methods and blending ratio as all of the treatment combinations resulted in values varying from 367.36 and 371.74 kcal/100g with no significant difference (p>0.05) among them. However, their energy contents were significantly lower than that of the control sample (372.27 kcal/100g).The high energy and carbohydrate values obtained in this study suggest that cassava-based products could be utilized as a reliable food and energy security crop as proposed by FAO (2008); especially owing to their content of some of the most desirable nutritional compounds like carbohydrate, fat, protein and minerals.

Effects of varieties, drying methods and blending ratio on sensory acceptability of Cassava-Wheat composite bread

Color

As show in Table 3, there was no significant differences (p>0.05) in the color acceptance between the control and breads from composite flours up to 42.90 g level due to blending ratios. However, variety and drying methods had a significant effect (P<0.05) on color acceptability of cassava flour composite breads. Higher mean score of color (4.36) was recorded for Kello variety cassava flour containing bread and the lower (4.17) for Qulle variety containing breads. Moreover, maximum mean score of color (4.41) was observed for sun dried cassava flours containing breads and lower (4.13) sun dried samples. Generally, color acceptability of composite breads was not significantly (p>0.05) lower than that of the wheat bread. Color acceptability scores of the composite breads and the control wheat bread were all in the range of 4.20 and 4.36 indicating that level of substitution of cassava flour in composite bread does not change the color of composite breads.

Significant difference (p<0.05) prevailed in texture acceptability scores among blending ratios of composite bread samples (Table 3). However, cassava variety and drying method had no significant (p<0.05) effect on texture acceptability of composite bread samples. The highest mean score (3.98) was observed for 100 g wheat bread followed by 3.79 for the composite with 11.12 g cassava. The least score (3.15) was for the bread of the highest cassava flour proportion (42.90 g). This showed that, the level of supplementation influences the quality of dough thereby that of the texture of the bread. As the proportion of cassava increased acceptability of bread texture reduced. The highest cassava proportion resulted in a low score (3.15) indicating that the texture was not close to neither like nor dislike.

Flavor

Different levels of blending ratio had a significant effects (p<0.05) on flavor acceptability of composite breads (Table 3). The highest flavor score (3.84) was recorded for 100 g wheat flour bread and the lowest score (2.90) was for the composite bread with 42.9 g cassava flour. A decrease in the acceptability of the bread flavor was observed with an increase in the amount of cassava flour in the formulation. The flavor of the 11.12 g and 25.00 g cassava flour composite breads was found superior than 42.90 g of the blended, scoring higher on the 5 point hedonic test. Generally, the flavor acceptability of the composite breads was significantly lower than that of the control wheat bread. There was no significant differences (P>0.05) due to cassava varieties in respect of the flavor acceptability of cassava flours composite bread samples. Drying methods had also no significant (p>0.05) effect on flavor of composite bread samples.

Taste

There was a significant differences (P<0.05) among

Table 3. The main effects of drying method, cassava variety and blending ratio on sensory acceptability of cassava-wheat bread.

Treatment	Color	Texture	Flavor	Taste	Appearance	Over all acceptance
Drying			**Main effects of drying methods**			
BDOv	4.13±0.72[b]	3.52±0.66[b]	3.39±0.77[b]	3.30±0.81[b]	3.17±1.43[b]	3.68±0.74[b]
BDSu	4.41±0.54[a]	3.49±0.84[b]	3.35±0.68[b]	3.27±0.72[b]	3.45±0.79[b]	3.65±0.67[b]
Cont.	4.20±0.64[b]	3.98±0.62[a]	3.84±0.77[a]	3.82±0.69[a]	3.82±0.87[a]	4.12±0.66[a]
Mean	4.26	3.54	3.40	3.32	3.35	3.70
Cv (%)	14.94	21.16	21.48	22.96	33.80	18.99
Blending			**Main effects of Blending ratio**			
DVB1	4.20±0.66[a]	3.79±0.66[b]	3.64±0.64[b]	3.65±0.61[a]	3.52±0.62[b]	4.01±0.63[a]
DVB2	4.25±0.64[a]	3.58±0.50[c]	3.57±0.51[b]	3.36±0.64[b]	3.51±1.57[b]	3.81±0.52[b]
DVB3	4.36±0.64[a]	3.15±0.92[d]	2.90±0.77[c]	2.85±0.82[c]	2.92±0.98[c]	3.19±0.68[c]
Cont.	4.20±0.64[a]	3.98±0.62[a]	3.84±0.77[a]	3.82±0.69[a]	3.82±0.87[a]	4.12±0.66[a]
Mean	4.26	3.54	3.40	3.32	3.35	3.70
Cv (%)	15.20	19.92	19.29	20.89	33.11	16.67
Variety			**Main effects of cassava variety**			
BDKv	4.36±0.66[a]	3.44±0.71[b]	3.35±0.72[b]	3.26±0.77[b]	3.30±1.42[b]	3.64±0.70[b]
BDQv	4.17±0.63[b]	3.56±0.80[b]	3.39±0.73[b]	3.31±0.77[b]	3.33±0.82[b]	3.70±0.71[b]
Cont.	4.20±0.64[ab]	3.98±0.62[a]	3.84±0.77[a]	3.82±0.69[a]	3.82±0.87[a]	4.12±0.66[a]
Mean	4.26	3.54	3.40	3.32	3.35	3.70
Cv (%)	15.12	21.10	21.48	22.95	34.04	18.98

Values with the same letters in the same column are not significantly different (at p>0.05) (dwb). Cont. = control (100 g wheat flour bread), BVOv = Oven dried cassava flours blended breads, BVSu = Sun dried cassava flours blended breads, DVB1= 11.12 g sun and oven dried cassava flours mixed with 100 g wheat flour, DVB2= 25.00 g sun and oven dried cassava flours mixed with 100 g wheat flour, DVB3= 42.90 g sun and oven dried cassava flours mixed with 100 g wheat flour, BDKv = Kello variety processed by both drying methods blended bread, BDQv = Qulle variety processed by both drying methods blended bread, CV= coefficient variance.

blending proportions regarding taste attribute of composite bread samples (Tables 3). The highest mean value of taste (3.82) was recorded for 100 g wheat flour bread followed by 3.64 for 11.12 g, 3.36 for 25.00 g and 2.85 for 42.90 g cassava flours composite breads. A decrease in taste acceptability scores was observed with an increase in the levels of cassava flour in the composite flour bread. However, the panelists' scores for 11.12 g cassava flour composite bread sample were comparable to of the control wheat bread.

No significant difference (P>0.05) was detected between cassava varieties for taste acceptability of cassava flours composite bread samples. There was a significant (p<0.05) difference in taste scores of composite bread samples between drying methods. Most panelists preferred the taste of oven dried cassava flours composite bread (3.30) followed by sun dried cassava flours composite bread (3.27).

Appearance

Appearance of composite breads had a significant (P<0·05) differences among blending ratios (Table 3). The highest mean score (3.82) of appearance was recorded for 100 g wheat flour bread followed by 3.52 for 11.12 g, 3.51 for 25.00 g and 2.92 for 42.90 g cassava flours composite breads. A reduction in the appearance mean score was observed with an increase in the amount of cassava flour in the composite flour bread.

There was no significance difference (P>0.05) between cassava varieties regarding scores of appearance of cassava flours composite breads (Table 3). Drying methods also had no significant (p<0.05) effect on appearance of composite bread samples. In general the appearance scores attained by the composite breads were significantly lower than that of the control sample.

Over all acceptability

Overall acceptability of the composite flour breads exhibited significant (P<0·05) differences among blending ratios (Table 3). However, drying method and variety had no significant difference (P>0.05) on overall acceptability of composite flour breads. The highest overall panelist acceptability (4.12) was recorded for 100 g wheat flour bread followed by 4.01 for 11.12 g, 3.81 for 25.00 g and 3.19 for 42.90 g cassava flours composite breads. A decrease in the consumer acceptability was observed with an increase the amount of cassava flour in the composite flour bread. The overall acceptability score of the bread with lowest proportion of cassava flour containing breads was well above 4 (like moderately) in a scale of five suggesting that it was well above minimum acceptable score. Therefore, as with all other sensory parameters, supplementation of cassava flour up to 25 g in 100g wheat flour was observed to have no difference from wheat flour bread (control) with respect to overall acceptability. This result is in agreement with cookies made from modified taro starch (Ojinnaka *et al*, 2009) and cookies made from taro flour (Nip *et al.,*1994).

Conclusions

This study was carried out to investigate the effect of cassava varieties, drying methods and blending ratio on proximate compositions and sensory acceptance of cassava-wheat composite breads. The ash, fiber and carbohydrate contents of composite breads improved significantly as blending levels of cassava flour increased whereas protein and fat contents get decreased. The results showed that, cassava flour substituted into wheat flour provided excellent benefits regarding improvement in nutritional quality of cassava-based products. The analysis shows that, the wheat bread did not differ significantly (P>0·05) from the 11.12 cassava flour supplemented breads in the sensory attributes of color, texture, taste, flavor, appearance and overall acceptability.

However, at higher level of cassava flour supplementation, a significant difference occurs in comparison with the white wheat breads at the same probability level. Hence cassava flour substitution at 11.12 g in bread making would therefore make a good and acceptable sensory attributes with probably no significant differences (*P*<0·05) from the wheat bread. The hedonic scale test conducted reveals that the wheat bread was preferred in terms of all attributes tested followed by the lower level cassava flour supplemented bread samples.

This could be as a result of the familiarization of the consumers to the normal wheat bread. It is believed that public enlightenment on the nutritional importance of cassava flour fortified foods would help enhance the acceptability of the cassava flour supplemented breads. Further studies are required to investigate the impacts of anti-nutrients and storage period on cassava-wheat composite bread.

ACKNOWLEDGEMENT

Authors are thankful to the Hawassa Agricultural Research Centre (HARC), for supplying the cassava roots samples used in this work, Ethiopia Ministry of Education for granting us financial support and Food Science and Post-Harvest Technology Department of Haramaya University for the all rounded support in providing reagents, chemicals and all their laboratory facilities.

REFERENCES

AACC (2000). Approved Methods of the American Association of Cereal Chemists. 10th Edn., AACC International, St. Paul, MN.

AOAC (2002). The Association of Official Analytical Chemists. 15th Ed., Washington, D. C., 1995.

Bennett FD, Nozzolillo C (1987). How many seeds in a seeded Breadfruit, *Artocarpus altilis* (*Moraceae*)? Economic Botany, NewYork Botanical Garden, Bronx, NY 10458, 41(3): 370-374.

Bradbury JH, Holloway DW (1988). Chemical composition of tropical root crops from the south pacific: Significance for human nutrition. Canberra: *Australian Center of International Agricultural Research*,pp.103-104.

Cardoso AP, Mirione E, Ernesto M, Massaza F(2005). Processing of cassava roots to remove cyanogens. *Journal of Food Composition and Analysis*. 18:451-460.

Desse G, Taye M (2001). Microbial load and microflora of cassava (*Manihot esculenta* Crantz) and effect of cassava juice on some food borne pathogens. *The Journal of Food Technology Africa*, 6:21-24.

Eddy NO (2004). Effect of Processing on the Chemical Composition of Some Nigerian Food Crops. *M.Sc Theses*, University of Uyo, Uyo,Nigeria.

Edema MO, Sanni LO, Sanni AL (2005). Evaluation of maize-soybean flour blends for sour maize bread production in Nigeria. *Africa Journal of Biotechnology*. 4(9): 911-918.

Enwere NJ(1998). Food of Plant Origin. Afro-orbis Publications limited, University of Nigeria, pp:194-199.

Essien EA (2006). Evaluation of the chemical composition and industrial potentials of cocoyam. M.Sc Theses, University of Uyo, Nigeria.

FAO/WHO (1991). Joint FAO/WHO food standards program. Rome: Codex alimentarius, Commission XII, Supplement 4, FAO/ WHO.

FAO (2008). Food and Agriculture Organisation, Statistics series No. 95. Food and Agriculture Organisation of the United Nations, Rome.

Giami GY Amasisi T, Ekiyor G (2004). Comparison of bread making properties of composite flour from kernels of roasted and boiled African bread fruit (*Treculia africana*) seed. *Journal of Material Research.* 1(1):16-25.

Hoffer LI (2007). Methods for measuring sulfur amino acid metabolism. *Current Opinion in Clinical Nutrition and Metabolic Care*, 5:511-517.

Hussain S, Anjum FM, Butt MS, Khan MI, sghar AA (2006). Physical and sensoric attributes of flaxseed flour supplemented cookies. Turkish Journal of Biology. 30:87-92.

IITA/UNICEF (1990). Cassava in Tropical Africa; A Reference Manual. IITA, Ibadan, Nigeria, p.176.

IITA (International Institute of Tropical Agriculture), 2005. Production of cassava flour. Annual Research Report, Ibadan, Nigeria.

Montagnac JA, Davis CR, Tanumihardjo SA(2009). Nutritional Value of Cassava for use as a Staple Food and Recent Advances for Improvement. *Comprehensive Review in Food Science and Food Safety,* 8: 181-188.

Nwabanne JT (2009). Department of Chemical Engineering, Nnamdi Azikiwe University, P.M.B 5025, Awka, Nigeria.

Nassar AG, AbdEl-Hamied AA, El-Naggar EA (2008). Effect of citrus by-products flour incorporation on chemical, rheological and organolepic characteristics of biscuits World Journal of Agricultural Science .4 (5): 612-616.

Njintang YN, Mbofung CM, Balaam F, Kitissou P, Scher J (2007).

Effect of taro (*Colocasia esculenta*) flour addition on the functional and Alveographic properties of wheat flour and dough. *Journal of the Science of Food and Agriculture*. 88(2):273-279.

Nip WK, Whitaker CS, Vargo D (1994). Application of taro flour in cookie formulations. International Journal of Food Science and Technology.29:463-468,9(4):701-713.

O'Brien GM, Mbome L, Taylor AJ, Poulter NH (1992). Variations in cyanogens content of cassava during village processing in Cameroon. *Food Chemistry*, 44:131-136.

Olaoye OA, Onilude AA, Oladoye CO (2007). Breadfruit flour in biscuit making: effects on product quality*. African Journal of Food Science*, 20-23.

Omole JA (1977). Cassava in the nutrition of layer, In: *Cassava as Animal Feed*. Nestel B, Grahams M (Eds). Process Workshop (IITA), Ibadan.

Oyenuga VA(1972).Nigerian Food and Feeding Stuffs, Ibadan University of Ibadan press.

Prosky L, Asp NG, Schweizer TF, DeVries JW, Furda I, Lee SC (1994). International Journal of Association of Official Analytical Chemists (AOAC) 77:690–69.

RMRDC (2004). "Cassava Report on Survey of Agro Raw Materials in Nigeria." Raw Material Research and Development Council. *Federal* Ministry of Science & Technology, Abuja.

Sanni LO, Maziya DV, Dixo B, Akanya CI, Alaya Y, Egwuonwu CV, Okechukwu RU, Ezedinma C, Akoroda M, Lemchi J, Ogbe F, Okoro E, Tarawali G, Mkumbira J, Patino M, S.semakula G, Dixon A (2005). Standards for cassava products and guidelines for export. International Institute of Tropical Agriculture, Ibadan, Nigeria**.** pp.11-39.

Steel RGD, Torrie JH (1980). Principles and Procedures of Statistics. 2nd Ed. Mc Grow-Hill, New York, USA.

Taye M (1994). Cassava in Southern and South Western Ethiopia. Cassava News letter, 18: 6-7. CIAT, Colombia.

Taye M (2000). Some quality changes during storage of cassava root. *The Journal of Food Technology*. Africa, 5: 64-65.

Therberger RL, Caveness FE, Herren HR, Lena KM, Neuenschwander P, Yaninek JS (1985) Common African pests and diseases of cassava. Ibadan: International Institute of Tropical Publc, pp. 2-22.

Wenham (1995)."Post-harvest deterioration of cassava-abiotechnology perspective," FAO Plant Production and Protection Paper. 130.

Westby (2002)."Cassava utilization, storage and small-scale processing," in *Cassava*, R. J. Hillocks, J. M. Thresh, and A. C. Belloti, Eds., CAB International.pp. 281–300.

Zhang P, Wang WQ, Zhang GL, Kaminek M, Dobrev P, Xu J, Gruissem W (2010). Senescence-Inducible Expression of Isopentenyl Transferase Extends Leaf Life, Increases Drought Stress Resistance and Alters Cytokinin Metabolism in Cassava. J. Integrative Plant Biology 52(7):653–669.