International Journal of Agricultural Research and Food Production
ISSN: 2536-7331 (Print): 2536-734x (Online)
Volume 4, Number 2, June 2019
http://www.casirmediapublishing.com

# Effect of Hydrocolloid Treatments on the Proximate and Nutritional Properties of Breads Produced with Wheat-Cassava Composite Flour

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## ABSTRACT

*The flour samples studied contained moisture in the range of 11.10 11.90%. The cassava flour 0:100 (W-C) had a moisture content of 11.10 % while the wheat flour 100:0 (W-C) had a moisture content of 11.90%.The fat content of the flour samples were in the range of 0.60-1.50%. The cassava flour 0:100 (W-C) had the lowest (0.60 %) fat content while wheat flour 100:0 (W-C) had the highest (1.50 %) fat content. The ash contents of the flour samples were in the range of 1.94 - 2.96%. The highest (2.96 %) ash content was recorded for the wheat flour sample 100:0 (W-C), while the lowest (1.94 %) ash content was recorded for the cassava flour. The protein value of the flour samples were in the range of 0.59 - 12.20 %. Wheat flour 100:0 (W-C) had the highest (12.20 %) protein content while the cassava flour 0:100 (W-C) protein values was the lowest (0.59 %).The crude fibre contents of the flour samples ranged from 2.06 % to 3.18 %. The cassava flour 0:100 (W-C) had the highest (3.18 %) fibre content while the wheat flour 100:0 (W-C) fibre content was 2.06%. The cassava flour sample 0:100 (W-C) had the highest (82.59 %) carbohydrate content and the wheat flour 100:0 (W-C) recorded the lowest (69.38 %) carbohydrate content. The crude fibre contents of the bread loaves were in the range of 0.39 % -2.34 %. The highest crude fibre was recorded for the bread loaf from sample WC-EGCm (1:1:2) while the lowest crude fibre was recorded for the bread loaf from control the (100 % wheat flour) sample. There were significant differences (p<0.05) in the ash contents of all the bread loaves from the flour samples with exception of the bread loaves from samples WC-EGCm (2:1:1) and WC-EGCm (1:1:2) which had similar ash contents. The bread sample from sample 90:10 (W-C) had the highest (3.42 %) ash content while that from sample WC-EG had the least (0.67 %) ash content There were significant differences (p<0.05) in the ether extract or fat content values of some of the bread loaves. Bread loaves from 100:0 (W-C) and WC-EG flour samples had fat contents which were not significantly different (p<0.05) from each other. However, the bread loaf from sample WC-Cm had the highest fat content while that from the reference 90:10 (W-C) flour sample had the least ether extract content. The protein contents of the bread loaves from all the flour samples differed significantly (p<0.05) from each other. The same were the carbohydrate contents of the bread loaves which also were significantly different (p<0.05) from each other. The bread loaf from the gelatin treated 80:20 wheat-cassava flour sample (WC-G) had the highest (20.23 %) protein content and that was significantly different (p<0.05) from the protein content (19.42 %) recorded for bread loaf from egg white treated 80:20 wheat-cassava composite flour sample (WC-E). The loaf with the highest carbohydrate content was obtained from the reference 90:10 (W-C) flour sample and was followed by the bread loaf which was obtained from 80:20 wheat-cassava flour treated with a combination of egg white, gelatin and carboxymethyl cellulose in the ratio of 1:1:2, (sample WC-EGCm).*

***Keywords:*** *Wheat, cassava, hydrocolloids, flour, bread.*

## INTRODUCTION

Bread and other wheat flour based products are popuslar in Nigeria and other parts of the world. Bread is the most popular among all the wheat based products. It celebrates the richest and simplest pleasures of daily living. In most European cultures, it is the single inevitable presence at the table during all the three meals of the day (Kent, 2000). In Nigeria, it is consumed by people in every socio-economic class and it is acceptable to both children and adults (young and old). Bread has gained wide consumers' acceptance for many years in Nigeria (Badifu *et al.,* 2005; Abulude, 2005).

Food hydrocolloids are group of improvers commonly used in food industry. Food hydrocolloids are high-molecular weight hydrophilic biopolymers used as stabilizers functional ingredients in foods. They include gums which are used for retarding staling and for improving the quality of freshly baked products. These hydrocolloids help to improve dough stability during proofing of the bread loaves (Zlatica *et al.*, 2009). These compounds commonly named gums are capable of affecting both the rheology and texture of aqueous systems, stabilization of emulsion, suspensions and foams (Dziezak, 1991). Hydrocolloids have been used in gluten free breads to improve their texture (Mollakhalili *et al.*, 2015). In the baking industry researches have shown that hydrocolloids such as arboxymethyl cellulose (CMC), hydroxypropylmethyl cellulose (HPMC), methylcellulose (MC), guar gum, Arabic gum, xanthan gum and others can be used as gluten substitutes in the formation of gluten free bread (Toufeli *et al.*, 1994; and Lazaridou *et al.*, 2006). Studies on the use of wheat-cassava composite flour in bread making showed that cassava flour can replace wheat flour up to 10 % level for the production of satisfactory products (Akobundu *et al.*, 2005)). Bread produced from wheat-cassava composite flour with 20 % or more cassava flour is inferior in quality to 100 % wheat flour bread (Giami *et al.*, 2004). Such breads are heavy, lack desirable volume, do not have well vesiculated crumb, and have inferior organoleptic properties. These defects from composite containing more than 10 % cassava flour can be minimized by the use of appropriate hydrocolloids. The aim of the work was to determine the proximate composition of bread loaves produced from hydrocolloid treated 80:20 wheat-cassava composite flour.

## MATERIALS AND METHODS

Sources of Materials

Freshly harvested six months old sweet cassava (*Manihot esculenta*) tubers were obtained from the Root Crop Research Institute, Umudike Umuahia; Abia State and brought to Imo State Polytechnic Cassava Processing Mill the same day where it was processed into cassava flour. The hydrocolloids, xanthan gum, guar gum, carboxymethyl cellulose and gelatin were procured from a chemical store in Onitsha in Anambra state, and eggs from a poultry farm in Owerri, Imo State. Half bag of wheat (Golden Penny Prime) flour and other baking ingredients such as fat, yeast, sugar, and salt were purchased from bakery shops in Owerri. The experiments were carried out in the laboratories of Food Science and Technology and Nutrition & Dietetics departments of Imo State University Owerri.

### Cassava Flour Production

A variety of sweet cassava (*Manihot esculenta*) tubers were used to prepare cassava flour. Freshly harvested tubers of cassava were sorted and the bad ones removed. The sorted cassava tubers were peeled manually using knives then washed and grated using mechanical grater. The grated pulp was tied in sack- bag and dewatered using hydraulic press. It was then pulverized and oven dried at 60 oC using hot air oven (Model D25, Genlab Widnes Inc). The dried samples were milled finely and sieved using sieve of 0.5 mm mesh size. The cassava flour was packaged in polypropylene bag, from which samples were withdrawn for blending with wheat flour.

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http://www.casirmediapublishing.com

### Baking Process

The dough samples from the various wheat-cassava composite flour, treated with egg white, gelatin and CMC respectively and in combination were baked using the straight dough method of Chauhan *et al.* (1992). All the ingredients were thoroughly mixed in a z-blade mixer to form dough followed by cutting. The cut dough were placed in, a baking pan greased with baking fats accordingly. The formed doughs were covered with greased bread wrapper. The doughs were fermented for 90 min at room temperature (28 ° C + 1° C), proofed at 35 – 40 ° C for 90 min, and baked in an oven maintained at 230 °C – 250 °C for 30 min. After cooling, the bread samples were packaged in low density polyethylene bags at room temperature until they were used for analysis.

### Proximate Analysis

Proximate analysis was carried out in triplicates using the method described by AOAC (2005).

### Data Analysis

The values (on dry weight basis) were subjected to statistical analysis using analysis of variance (ANOVA). Regression analyses of the data were carried out. The standard deviations of the results from the means were also calculated. Significant differences among the means were established at 5% level using Duncan's multiple range tests. ssss

## RESULTS AND DISCUSSION

Proximate Compositions of the Flour Samples

The four flour samples contained moisture in the range of 11.10-11.90% (Table 1) and the moisture content of the cassava flour sample 0:100 (W-C) was 11.10 %. Charles *et al.* (2005), Shittu *et al.* (2007) and NIS (2004) had respectively stated moisture content ranges of 9.2-12.3 % and 11.0 -16.0 % for cassava flour. The wheat flour sample 100:0 (W-C) used for this study had a moisture content of 11.9 % and this level of moisture is good for wheat flour intended for storage. The optimum storage moisture level recommended for wheat is less than 12.5 % (Debraszczyk, 2005). Water is an important parameter in the storage of flour; very high levels greater than 12% allow for microbial growth and thus low levels are appreciable and give longer shelf life (Harris and Koomson, 2011). The suitability of foods for further use in processing into products according to Ensminger *et al.* (1995) is enhanced by lower moisture content. In general, the lower the moisture contents of flour, the longer the potential storage life (Harris and Koomson, 2011). The fat contents of the flour samples were in the range of 0.60-1.50 %. The cassava flour had the lowest (0.60 %) fat content and its fat content is higher than 0.10 - 0.40 % range reported for cassava flour (Charles *et al.*, 2005). The wheat flour had 1.50 % fats which fell within the range of 1.0-2.0% revealed for wheat flour (Ihekoronye and Ngoddy, 1985). The low fat contents of the flour samples suggested that the flours will be less prone to lipid related forms of deterioration (rancidity).The ash contents of the flour samples were in the range of 1.94 - 2.96 %. The highest (2.96 %) ash content was recorded for the wheat flour sample while the lowest (1.94 %) ash content was recorded for the cassava flour. Ash content is a reflection of the mineral contents in the food.

The protein contents of the flour samples were in the range of 0.5-12.20 %. Wheat flour had the highest (12.20 %) protein content while the cassava flour protein was the lowest (0.59 %). The protein contents of the wheat flour and wheat-cassava composite flour samples were within the range 0.1-0.7% for cassava flour and (10-15 %) (Montagnac *et al.,* 2009). Wheat flour is unique for bread making largely due to its gluten protein (Nwanekezi, 2013). The cassava flour does not contain gluten protein. Therefore, blending of wheat flour with cassava flour reduced the level of protein and the gluten protein of the composite flour samples 90:10 (W-C) and 80:20 (W-C). The crude fibre contents of the flour samples ranged from 2.06 % to 3.18 %. The cassava flour had the highest (3.18 %) fibre content while the wheat flour fibre content was 2.06 %. The crude fibre content of the wheat flour was within the range of 1.5 - 2.5 % (Ihekoronye and Ngoddy, 1985) or 1.7 - 2.6 % (Montagnac *et al.,* 2009). Crude fibre represents organic residue and is largely composed of cellulose and lignin which are indigestible by humans (Onwuka, 2005). The fibre content of cassava flour makes it a good choice for bowel health. Dietary fibre was reported to lessen the risk of variety of disease conditions, including cancer, diabetes, diverticulitis and constipation (Montagnac *et al.,* 2009). The cassava flour sample 0:100 (W-C) had the highest (82.59 %) carbohydrate content and the wheat flour contained the lowest (69.38 %) carbohydrate value. The carbohydrate content of the wheat flour with a moisture content of 14 % was within the range of 54 to 62 % (*Shittu et al.,* 2007). The carbohydrate content obtained for the wheat flour was higher probably due to the low moisture content of the sample. Carbohydrate is an excellent source of energy and provides fuel for proper functioning of the brain (Zvinavashe *et al.,* 2011). The primary role of carbohydrate is to supply the body's cell with glucose, which is the basic unit of carbohydrate and an important energy source (Shittu *et al.,* 2007). Carbohydrate also maintains blood glucose levels and has role in gastrointestinal health (Zvinav ashe et *al.,* 2011).

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http://www.casirmediapublishing.com

Table 1: Proximate Composition of Flour Samples

| Flour sample | Moisture (%) | Ether extract( %Fat) | Ash (%) | Protein (%) | Crude Fiber ( %) | Carbohydrate (%) |
|---|---|---|---|---|---|---|
| 80:20 *W*-C | 11.75±0.04[a] | 1.30±0.01[a] | 2.76±0.01[c] | 9.88±0.01[c] | .28±0.02[b] | 72.03±0.02[b] |
| 90:10 *W*-C(Ref.) | 11.80±0.01[a] | 1.40±0.02[a] | 2.86±0.03[b] | 11.04±0.04[b] | 2.17±0.02[c] | 70.73±0.4[c] |
| 100:0 *W*-C(Cont.) | 11.90±0.02[a] | 1.50±0.01[a] | 2.96±0.01[a] | 12.20±0.03[a] | 22.06±0.04[d] | 69.38±0.04[d] |
| 0:100 *W*- C | 11.10±0.01[b] | 0.60±0.03[b] | 1.94±0.02[d] | 0.59±0.02[d] | 3.18±0.02[a] | 82.59±0.08[a] |
| LSD | 0.33 | 0.28 | 0.021 | 0.031 | 0.03 | 0.082 |

Values are means ± standard deviations from the means. Mean scores with different superscript letter(s) on the same column are significantly different ($p<0.05$). LSD=Least Significant Difference ($p<0.05$).

Key:

80:20 (W-C) = 80% wheat flour + 20% cassava flour

90:10 (W-C) (Ref.) = 90% wheat flour + 10 % cassava flour (Reference sample)

100:0 (W-C) (Cont.) = 100%wheat flour (control flour sample)

0:100 (W-C) = 100% cassava flour

LSD = Least significant difference

## Crude Fibre

The average proximate contents of flour samples and bread produced with hydrocolloid treatments are shown on Table 2. The lowest crude fibre content was recorded for the bread produced from the 100 % wheat (control) flour sample. The crude fibre content of wheat flour was significantly lower than those of cassava flour and wheat-cassava composite flour samples (Table 2). The low crude fibre content of 100 % wheat flour bread was as a result of bran and germ removal during wheat flour milling. The range of crude fibre (based on dry weight) of bread samples was from 0.39 to- 2.34 %. The bread from treatment WC-EGC (1:1:2) had the highest (2.34 %) crude fibre on dry weight basis because it contained higher ratio of carboxymethyl cellulose in the 3 hydrocolloid combination treatment of 80:20 wheat-cassava composite flour used for baking it. Higher ratio carboxymethy cellulose to egg white and gelatin increased the crude fibre content of wheat-cassava bread sample.

## Nutritional Implications of Fibre Content of Samples

CMC is non-toxic, and generally considered to be hypoallergenic as a major source of fibre (Gimeno *et al.*, 2004). Crude fibre represents organic residue, it is made largely of cellulose together with a little lignin. Crude fibre theoretically includes materials that are indigestible in human and animal organism (Onwuka, 2005). Therefore, consumption of bread produced with 80:20 wheat-cassava composite flour treated with the combination of egg white, gelatin and carboxymethyl cellulose in a ratio of 1:1:2 would aid digestion and help in bowel movement. Foods rich in fibre may lessen the risk of a variety of diseases and conditions, including cancer, diabetes, diverticulitis and constipation as well as limiting calorie intake (Simpson and Cowbell, 2015).

## Ash Content

There were significant differences ($p<0.05$) in the ash contents of the bread loaves (Table 2). The bread produced from the flour sample 90:10 (W-C) (reference flour) had the highest ash content, followed by bread produced from 100 % wheat flour (control) sample. The ash contents were in the range of 0.69 - 3.42 %. Ash is a measure of the mineral contents of the samples (Abulude, 2005). Which suggests that the bread samples with high amount of ash content had high percentage of minerals.

## Nutritional Importance of Ash Content of Samples

Ash is an organic compound that aids in the metabolism of other compounds such as fat and oils (Muhammad, 2011). Ash equally speeds up metabolic processes, improves growth and development (Muhammad, 2011).

## Ether/Fat Content

The ether extract (fat contents) on dry weight basis ranged from 1.91 to 15.57%. Sample WC-ECm was observed to have the highest (15.57 %) ether extact (fat) value, followed in order by the bread samples WC-Cm (12.85 %), WC-EGCm (2:1:1) (9.87 %), 100:0 (W-C) (7.62 %), and WC-EG (7.41 %). The lowest (1.91 %) fat content was observed for the bread produced from the flour sample WC-G.

Nutritional Implications of FAT Content of Samples

All samples but sample WC-G are high fat/energy products. The nutritional implications of breads produced with these hydrocolloids have high cholesterolemic effect. Which is a risk factor for obesity, cardiovascular diseases etc.

## Protein Content

The protein content of the bread samples had values in the range of 11.78 - 20.23 %. The results showed that most of the 80:20 wheat-cassava composite flour samples treated with hydrocolloids had higher values of protein than the reference flour sample and even the control flour sample. The highest (20.23 %) protein content was obtained in the bread sample WC-G, followed in order by bread samples WC-E and WC-EG which had protein contents of 19.42 % and 19.32 % respectively. The lowest (11.78 %) protein content was obtained the flour sample WC-Cm, bread. The high protein content of bread sample WC-G could be attributed to gelatin that is largely composed of amino acids, glycine and proline, all being amino acids and building blocks of proteins (Grinberg *et al.,* 1988 ;Takashi, 2011). The bread samples WC-E and WC-EG contained high values of protein because the combination of egg white with gelatin. Generally, egg white contains 57 % of whole egg's protein (Scott *et al.,* 2001). This implied that bread samples produced from 80:20 wheat cassava composite flour treated with gelatin and egg white singly or in combination with other hydrocolloids would have higher protein content than the bread produced from the 100 % wheat flour. Addition of these types of hydrocolloids to flour suggested this processing method as being important for amelioration of protein deficiency in all carbohydrate staple.

## Nutritional Implications of Protein Contents of Samples

Results suggested that these improvers have the potentials of overcoming protein malnutrition among the people. Proteins are essential compounds of living cell. They are polymers of amino acids and are nutrients needed by the human body for growth and maintenance of body cells (Scott *et al.,* 2001). Egg provides means through which the protein need of a populace can be met. It has various uses and contains many essential nutrients (Scott *et al.,* 2001).

## Carbohydrate Content

The carbohydrate contents of the bread loaves ranged from 64.74 to 78.42 %. The highest (78.42 %) carbohydrate content was obtained in the reference 90:10 (W-C) bread sample. The bread produced from the 80:20 wheat-cassava flour would have higher carbohydrate contents than the control sample because cassava has high (82.59 %) carbohydrate value than wheat (69.38 %), and the carbohydrate content of wheat-cassava composite flour increased with increased ratio of cassava flour in the composite flour (Table1)

## Nutritional Implications of Carbohydrate Content of Samples

The primary role of carbohydrate is to supply the body's cell with glucose, which is the basic unit of carbohydrate as an important energy source. Nearly all the energy required by the brain to function each day is supplied by glucose from the carbohydrate component of the diet (Zvinavashen *et al.,* 2011). The high carbohydrate content that was suggestive of high

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ISSN: 2536-7331 (Print): 2536-734x (Online)
Volume 4, Number 2, June 2019
http://www.casirmediapublishing.com

glucose content points to the probable use of cassava to boost the energy value of wheat products

Table 2: Proximate Composition of Bread Loaves Produced from Hydrocolloid- treated 80:20 Wheat-cassava Composite Flour (values on dry weight basis)

| Bread flour sample | Crude fiber(%) | Ash ( %) | Ether extract (%Fat) | Protein (%) | Carbohydrate (%) |
|---|---|---|---|---|---|
| WC-E | $1.16 \pm 0.02^{e}$ | $2.10 \pm 0.01^{c}$ | $4.13 \pm 0.02^{de}$ | $19.42 \pm 0.03^{b}$ | $73.19 \pm 0.03^{f}$ |
| WC-G | $1.15 \pm 0.0^{e}$ | $1.73 \pm 0.02^{f}$ | $1.91 \pm 0.01^{e}$ | $20.23 \pm 0.60^{a}$ | $73.12 \pm 0.28^{f}$ |
| WC-$C_m$ | $1.04 \pm 0.03^{f}$ | $1.21 \pm 0.02^{j}$ | $12.85 \pm 0.04^{ab}$ | $11.78 \pm 0.04^{l}$ | $74.98 \pm 0.15^{d}$ |
| WC-EG | $1.60 \pm 0.04^{b}$ | $0.67 \pm 0.02^{k}$ | $7.41 \pm 0.02^{cd}$ | $19.32 \pm 0.01^{c}$ | $71.00 \pm 0.11^{h}$ |
| WC-E$C_m$ | $1.35 \pm 0.04^{c}$ | $1.97 \pm 0.02^{d}$ | $15.57 \pm 0.03^{a}$ | $16.36 \pm 0.02^{f}$ | $64.74 \pm 0.07^{j}$ |
| WC-$C_m$G | $0.70 \pm 0.03^{i}$ | $1.47 \pm 0.02^{h}$ | $4.71 \pm 0.05^{de}$ | $15.00 \pm 0.03^{i}$ | $78.12 \pm 0.14^{b}$ |
| WC-EG$C_m$ (1:1:1) | $0.83 \pm 0.01^{b}$ | $1.92 \pm 0.03^{e}$ | $4.93 \pm 0.02^{cde}$ | $16.76 \pm 0.04^{e}$ | $75.56 \pm 0.15^{c}$ |
| WC-EG$C_m$ (2:1:1) | $0.86 \pm 0.02^{g}$ | $1.58 \pm 0.03^{g}$ | $9.87 \pm 0.04^{bc}$ | $17.00 \pm 0.03^{d}$ | $69.73 \pm 0.12^{i}$ |
| WC-EG$C_m$ (1:2:1) | $1.24 \pm 0.03^{d}$ | $1.28 \pm 0.02^{i}$ | $6.57 \pm 0.03^{cde}$ | $15.88 \pm 0.04^{h}$ | $73.93 \pm 0.12^{e}$ |
| WC-EG$C_m$ (1:1:2) | $2.34 \pm 0.02^{a}$ | $1.59 \pm 0.04^{g}$ | $6.23 \pm 0.04^{cde}$ | $14.32 \pm 0.05^{k}$ | $76.62 \pm 0.16^{b}$ |
| 90:10 (W-C (Ref) | $1.24 \pm 0.02^{d}$ | $3.42 \pm 0.04^{a}$ | $2.17 \pm 0.04^{e}$ | $14.75 \pm 0.05^{j}$ | $78.42 \pm 0.16^{a}$ |
| 100:0 (W-C) (Cont.) | $0.39 \pm 0.02^{j}$ | $3.26 \pm 0.03^{b}$ | $7.62 \pm 0.04^{cd}$ | $16.00 \pm 0.0^{g}$ | $72.73 \pm 0.08^{g}$ |
| LSD ($p \leq 0.05$) | 0.029 | 0.036 | 5.12 | 0.096 | 0.34 |

Values are means ± standard deviations from the means. Means with different superscript letter(s) in the same column are significantly different ($p < 0.05$).

LSD= Least Significant Difference
LSD= Least Significant Difference
WC= Wheat-cassava composite flour
E= egg white,
G= gelatin,
$C_m$= carboxymethyl cellulose (CMC),
90:10 (W-C) (Ref.) = 90% wheat + 10% cassava composite flour (reference sample)
100:0 (W-C) (Cont.) = 100% wheat flour or control flour sample.
WC-E=Wheat-cassava composite flour treated with egg white (singly)
WC-G= Wheat- cassava composite flour treated with gelatin (singly)
WC-$C_m$=Wheat- cassava composite flour treated with carboxymethyl cellulose (singly)
WC-EG= Wheat-cassava composite flour treated with egg white and gelatin (double improver)
WC-E$C_m$= Wheat-cassava composite flour treated with egg white and carboxymethyl cellulose (double improver)
WC-$C_m$ G=Wheat-cassava composite flour treated with carboxymethyl cellulose and gelatin (double improver)
WC-EG$C_m$ = Wheat-cassava composite flour samples treated with egg white, gelatin and carboxymethyl cellulose at ratios of 1:1:1, 2:1:1, 1:2:1, 1:1:2 (synergy improver).

International Journal of Agricultural Research and Food Production
ISSN: 2536-7331 (Print): 2536-734x (Online)
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http://www.casirmediapublishing.com

## CONCLUSION

Results of this study showed that hydrocolloids would improve the nutrients of breads produced with wheat- cassava composite flour. The typical bread is 100 % wheat flour but for some economic and ecological reasons the 100 % wheat flour content is unfeasible. The 80:20 wheat-cassava composite flour treated with gelatin yielded bread sample with the highest protein level (20.23 %) followed by bread (19.42 % protein) samples treated with egg white. Other nutrients were not found limiting in the produced bread samples.

## REFERENCES

AOAC. (2005). Official Methods of Analysis 18th edition Association of Official Analytical Chemist, Arlington, V. A Pp. 806 – 842.

Abulude, F. O. (2005). Distribution of selected minerals in some Nigerian white bread. Nigerian Food Journal 23: 139-143.

Akobundu, E. N.T. (2005). Bread making technology and ingredients for bread making in Nigeria Proceedings workshop.

Badifu, G. I. O., Chima, C. E., Ajayi Y. I and Ogoro, A .F. (2005). Influence of mango Mesocarp flour supplementation on micronutrient, physical and organoleptic qualities of wheat based foods. Nigerian Food Journal 23:59-68.

Charles, A. I., Sriroth, K and Huang, T. C. (2005). Proximate composition, mineral contents, hydrogen cyanide and phytic acid of 5 cassava genotypes. Food Chemistry 92: 615-620.

Chauhan, G. S., Zilliman, R. R. and Eskin, N. A. M. (1992). Dough mixing and bread making properties of guinea corn wheat flour blends, Int. J. Food Sci. Technol. 27: 701-705.

Dabraszcyk, B. J., Cambell, G. M and Gan, Z. (2005). Bread: A Unique Food In: Cereals and Cereal Products Chemistry and Technology. Dendy, D. A. and Dabraszcyk, B. J. (eds). Springer Science and Business Media, New Delhi, pp. 182-227.

Dziezak, J. D. (1991). A focus on gum. J. Food Technol. 45:115-132.

Ensminger, M. E., Ensminger, A. H., Konlande, J. E and Robinson, J. R. K. (1995). The Concise Encyclopedia of Food and Nutrition, C R C Press. Pp. 360-365.

Giami, S. Y., Adindu, M. N., Akuso, M. O. and Emelike, J. N. T. (2004).

Compositional, functional and storage properties of flour from raw and heat processed African breadfruit (*Treculia africana* Dence) seeds. Plant Food Hum.Nutri. 55:357-368.

Grinberg, N. V., Bibkou, T. M., Grinberg, V. Y. Colloid and Polymer Sci (1988) 266:52.doi.

Harris, M. A. and Koomson, C. K. (2011). Moisture-pressure combination treatments for cyanide reduction in grated cassava. Journal of Food Science 77(1):120- 124.

Ihekoronye, A. I. and Ngoddy, P. O. (1985). Integrated Food Science and Technology For the Tropics. Macmillan Publishers, New York, Pp. 296-301.

Kent, N. L. (2000). Technology of Cereals. 3rd Edition. Pergamon Press, New York. Pp. 180-187.

Lazaridou, A., Duta, D., Papageorgiou, M., Bela, N. and Biliaderis, C. G. (2006). Effects of hydrocolloids on dough rheology and bread quality parameters in gluten-free formations. J. Food Engineering 76: 1033-1047.

Mollakhalili, M. N., Mohammadifar, M. A. and Feizollahi, E. (2015). Gluten-free Bread Quality: A review of the improving factors. J. Quality and Hazards Control 2:81-85.

Montagnac, J. A., Davis, C. R and Tanumihardjo, S. A. (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.

Muhammad, M. A. (2011). Nutritional and anti nutritional analysis of *Gardensa acqualice*. M.Sc Dissertation submitted to post graduate school Usman Danfodio University Sokoto pp 63-88.

Nwanekezi, E. C. (2013). Composite flours of Baked Products and possible Challenges- A review. Nigerian Food Journal 31(2):8-17.

Onwuka, G. I. (2005). Food Analysis and Instrumentation. Theory and practice. Naphtali pub. Ltd Lagos.

Scott, T. A., Silversides, F. G., and Ross. D. A. (2001). Effects of freezing storage and dough improvers. Journal of Cereal Science 45: 1-7.

Shittu, T. A., Dixon, A., Awonorin, S. O., Sanni, L. O. and Maziya-Dixon, B. (2009). Bread from composite cassava-wheat flour.II: Effect of cassava genotype and nitrogen fertilizer on bread quality. Food Research International 41:569-578.

Simpson, H. T., Cowbell, B. J. (2015). Review article: dietary fibre, microbiota interactions. Aliment. Pharmacol Ther 42(2):158-79.

Takashi, K.L. (2011).Gelatin Production Department, Miyagi Chemical Industrial Co. Ltd 2-7-1, Wakabayashi, Wakabayashi. Ku, Sendai. Japan. p 984. Thames, E. and Hudson, B. (1997). Cassava New world. Encyclopedia

Toufelli, I., Smail, B., Shadarevian, S., Baalbaki, R., Khatkar, B. S., Bell, A. E. and Schofield, J. D. (1999). The role of gluten proteins in the baking of Arabic bread J. Cereal Science 30:255-265.

Zlatica, M. U., Li. B., and Huang, M. (2009). Hydrocolloids in foods. Carbohydratepolymer. 46:117-118.

Zvinavashe, E., Elbersen, H. W., Slingerland, M., Kolijn, S. and Sanders, J. P. M. (2011). Cassava for food and energy: Exploring potential benefits of processing of cassava into cassava flour and bioenergy at farmstead and community levels in rural Mozambique. Biofuels Bioproducts and Biorefining 5(2): 151-164