Evaluation of wheat cassava and soymalt composite flour influence on biscuit quality

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ABSTRACT

This study evaluated the effect of soy malt addition on properties of cassava-wheat composite flour and its suitability for biscuit production. Various mixes of cassava - wheat - soybean malt flours were analyzed for proximate composition, physicochemical properties, mineral and vitamin. Biscuits were produced from these various flour mixes and the acceptability determined by sensory evaluation. There were increases for crude protein, fiber, ash and fat as soy-malt flour addition increases and ranged from 14.52 - 21.96, 1.52 - 1.8, 2.66 - 3.01 and 3.97 - 10.02%, respectively, while the moisture, carbohydrate, sugar and starch content decrease and ranged from 8.12 - 8.73, 59.23 - 54.39, 1.70 - 1.46 and 73.14 – 68.15%, respectively. Physico-chemical properties such as swelling capacity, solubility, bulk density was found to increase and ranged from 237.50 - 257.00%, 227.5 - 265.0% and 0.64 - 0.71 g/cm³, respectively. The phosphorus, magnesium and potassium content ranges from 7.22 - 11.2, 9.25-12.69 and 1.37-1.24 mg/100g, respectively. The vitamin B₁ and vitamin E content increases with increasing level of cassava and soybean malt flour and range between 0.053-0.068 and 2.44-3.93 mg/100g, respectively. Sensory evaluation indicated that biscuit made from wheat-cassava-soymalt flour mixture with ratio of 70:15:15 compare favourably well with biscuit made from 100% wheat flour in terms of overall acceptable to the panelists. The results suggest that biscuits could be made from the different flour mixes and that soybean malt flour can be used for biscuit enrichment.

Keywords: Wheat, Cassava, Soybean, Biscuit quality, malt,

INTRODUCTION

Consumption of plant protein in the form of soybeans is one of the economical ways of preventing malnutrition because soybean is within the reach of many and possesses relatively high protein content (11TA, 1998). Protein present in soybean are used to replicate the viscoelastic properties of gluten present in wheat flour at contents up to 30% to produce different variety of baked products (Ribotta et al., 2004), as such soy flours can be partially substituted for wheat flour at contents up to 30% to produce different variety of baked products (Shogren et al., 2003). Although soybean is reportedly high in protein content, complete replacement of wheat flour by 100% of soy flour is however hard to achieve in bakery products because of the resulting beany flavor and compact texture. One of the continuing difficulties to the acceptance of soybean food products is their beany taste, which is caused by the lipoxygenase catalyzed oxidation of unsaturated fatty acid in soybean oil to volatile compounds. Studies have examined the removal of the beany flavor of soybean through germination. This undesirable flavor, as well as the presence of lipoxygenase isozymes that are the disadvantages associated with raw soybean have been reported to be overcome in many countries through germination (Mostafa and Rahma, 1987). Health benefits of soybeans can also be joined in sprouts generated during germination (Kumar et al., 2006). During the process of germination, the chemical compositions of the seed are changed, because the biochemical activity produces essential compounds and energy, for the formation of the seedling. Activation of hydrolytic enzymes occur which decay large molecular substances, such as starch, non-starch polysaccharides and proteins, to small molecular compounds. An increase of simple sugars, peptides and the amino acids of germinated seeds occur due to these processes (Yang et al., 2001; Rimsten et al. 2003; Saman et al., 2008). In addition to the change of the level of nutrients and the biochemical activities that occur during germination, bioactive components are also created (Fernandez-Orozco et al., 2008).

Soybean from which malt (controlled germination) can be formed is significant source of protein, meat-like products for vegetarians and for patients with special restraint such as controlled level of fat (Liu, 2000). Since soybean is not imported like wheat and
cheaper in Nigeria, it can serve as a way of improving the nutritive value of biscuit. Also, due to cost, can serve as potential of reducing the cost of biscuit if found suitable when combined with wheat flour. Cassava (Manihot esculenta Crantz) is main food crop produced in Nigeria but the chief constraint to cassava application is the quick microbial degradation after harvest. Shelf life of cassava roots is about 24-48 hours after harvest. One way to extend the shelf life of cassava is to make a dry product such as flour. In Africa, cassava flour has a great likely to serve as a substitute to wheat flour (Onyango et al., 2011), but flour quality consistency is a major drawback (Hershey et al., 2000) as well as its poorer baking properties. Cassava flour lacks gluten, has a very limited amylase activity and also differences in the composition of the starch fraction compared to wheat flour (Aryee et al., 2006).

Biscuit, a snack consumed mostly by the children and teenagers can form from wheat – cassava – soybean composite flour. Although cassava is high carbohydrate crop with very low protein content (Onabolu, 2001), the soybean flour can help to supplement this and improve protein content of the biscuit. Since animal protein such as meat and fish are expensive in developing countries like Nigeria, alternative plant sources which are cheaper and within reach need to be sought. The purpose of this study is therefore, to produce and assess biscuit from composite flour of wheat, cassava and soybean malt.

MATERIALS AND METHODS

Procurement of materials

Soybean, granulated sugar, baking powder and margarine were purchased from Sabo market in Ogbomoso, Nigeria. Wheat flour was achieved from eagle flour in Ogbomoso and cassava tubers were gotten from a local farm in Ogbomoso, Nigeria.

Sample preparation

Preparation of malt from soybean

Soybean was cleaned, weighed, soaked in water (soy: water; 1:3) for six hours so as to achieve a 45% moisture level. The water was changed after four hours, sodium benzoate was added to avoid fungal growth during germination, and the grain was re-soaked for another two hours. After two hours, the soaked grain was then drained, loaded onto holed tray lined with muslin cloth and covered with moist muslin. The tray was placed in a seed germinator at 20°C and 95% relative humidity for 72 hours. The germinated grain (Plate 1) was dried from 42% to 8% moisture content. The wasted rootlet was gently being brushed off and the malt was ground in a hammer mill. It was preserved in air tight glass jar and kept at low temperature until use (Mehanna and Martin, 1985).

Preparation of cassava flour

The cassava tubers were harvested fresh, peeled manually, washed and grated. The grated mush was packed into holed sack and pressed using the hydraulic press to drain out water after which it was sun-dried and it was then dry milled into flour (Ashaye et al., 2015).

Preparation of composite flour mixes

The various flour blends were made by mixing wheat flour, cassava flour and soybean malt flour together. The six flour samples for the study were: wheat flour 100% (A); cassava flour 100% (B); soy malt flour 100% (C); wheat/cassava/soy malt flour 90/5/5% (D); wheat/cassava/soy malt flour 80/10/10% (E) and wheat/cassava/soy malt flour 70/15/15% (F) respectively.

Biscuit preparation

Biscuit was prepared by mixing all the constituents (Flour, sugar, Egg, margarine, Baking powder) together to form a well founded a dough. The dough was then rolled out, cut into the designed shapes, placed on a lubricated tray and then baked in the oven at the temperature of 240 °C.

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![Fig. 1. Germinated soybean grain used for malting process](image)

Proximate composition

The samples were examined for moisture, protein (N x 6.25), crude fat, ash, crude fibre and carbohydrate resolute difference according to the method described by AOAC (2005).
**Physiochemical properties**

Bulk density was resolute by the method reported by Okaka et al., (1991). The swelling capacity was resolute by using the method of (Sathe and Salunkhe 1981) also pH values were determined using the standard methods described in AOAC (2005). The water absorption capacities of sample determined by the method of Sosulski et al., (1976)

**Mineral composition determination**

Selected minerals such as phosphorus, magnesium and potassium were mined from dry ash samples and resolute by atomic spectrophotometer (AOAC, 2005).

**Determination of vitamins**

Vitamin C (Ascorbic acid) was resolute using a spectrophotometer, according to the method of Klein and Percy (1982). The Vitamin B₃ and Vitamin E content of the flour samples were resolute by phosphomolydate method using alpha – tocopherol as the standard (Jayaprakasha et al., 2003).

**Sensory evaluation**

Biscuit was baked from each sample, detached from the oven, allowed to cool and then served to ten (10) judges. The panelists were made up of the students and workers of the Department of Food Science and Engineering, LAUTECH. The judges were asked to score the biscuit product for taste, colour, breakability, crispiness, rigidity and general suitability, by using a seven (7) point hedonic scale, where 1 to 7 represent’s dislike very much to like very much individually and neither like nor dislike was midpoint.

**Statistical analysis**

Statistical analysis involved the use of the Statistical Analysis System software package. Analysis of variance was performed by ANOVA procedures. Significant differences between means were determined by Duncan’s multiple range tests at a level of P < 0.05. All data were conveyed as means ± SD (standard deviation)

**RESULT AND DISCUSSION**

**Proximate composition of cassava, wheat and soybean flour mix**

The proximate composition of cassava wheat and soybean composite flour shown in Table (1). Results showed protein content of samples increased with increasing quantity of soybean and cassava flour and was found to be within the range of 14.52 – 21.96%. The increase in protein content of the mix was as a result of the replacement with soybean which is a higher source of protein. At present, soybean remains the world’s most important source of plant protein (Day, 2013). Moreover, malting of the soybean could has well have increased the protein content and this was in assignation to Wang and Fields (1978) who reported that malting, a old-style processing technology may help to improve the nutritional quality of protein. This could be recognized to a synthesis of enzymatic proteins by germinating seed. Soybean malt flour added at different percentages to the composite flour may have had a significant effect on the protein content. The crude fibre was found to increase with increasing level of soybean and cassava flour, it was found to be within the range of 1.52-1.82%. Fibre has been stated to lowers plasma cholesterol in the body, it also falls the incidence of colon cancer and rise the digestibility of food (Bell et al., 1990). The Ash content of the flour mixes increases with increased level in the addition of soybean and cassava flour. It was found to be within the range of 2.66 - 3.01%. This also implies a possibility increase in mineral content. The ash content (2.66-3.1%) of the composite flour detected in this study is alike to the ash content (1.7-3.1%) of malted sorghum-soy composite flour reported by Bolariwaa et al., (2015) and (2.9%) of composite flour produced from maize-soy flour as reported by Edema et al., (2005).

The fat content was also found to rise with the adding of soybean and cassava flour. It was found to be within the range of 3.97 -10.02%. The increase was as a result of replacement with soy flour, since the flour is not defatted. This may be due to the fact that soybean is a rich source of vegetable oils and at present, the world’s most important oilseed, used for the extraction of oil (Day, 2013). The moisture content was found to be within the range of 8.73 -9.95% with sample A which is pure wheat having the highest moisture content surveyed by sample B which is pure cassava and sample C which is pure soybean flour has the lowest content, but with cassava flour and soybean flour substitution, the moisture content was found to be within the range of 8.12 – 8.73%. The lower moisture would be an advantage, because low moisture content improves stability and extend preservation (Nnam, 2002). The moisture content of all the samples were below the 10% moisture level suggested for safe keeping flour samples (SON, 2007). The carbohydrate and starch...
Table 1. Chemical properties of cassava, wheat and soybean based composite flour

<table>
<thead>
<tr>
<th>Sample (%)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>9.95±0.149</td>
<td>38±0.46</td>
<td>7.28±0.58</td>
<td>8.12±0.19</td>
<td>8.43±0.11</td>
<td>8.73bc±0.17</td>
</tr>
<tr>
<td>Ash</td>
<td>1.72±0.10</td>
<td>3.71±0.06</td>
<td>3.10±0.21</td>
<td>2.66±0.13</td>
<td>2.87bc±0.04</td>
<td>3.01c±0.03</td>
</tr>
<tr>
<td>Protein</td>
<td>12.09±1.25</td>
<td>2.47±0.13</td>
<td>34.63±1.66</td>
<td>14.52±0.42</td>
<td>17.92±0.48</td>
<td>21.96±0.57</td>
</tr>
<tr>
<td>Fat</td>
<td>1.63±0.09</td>
<td>1.13±0.11</td>
<td>15.42±1.97</td>
<td>3.97b±0.16</td>
<td>6.96±0.15</td>
<td>10.02±0.06</td>
</tr>
<tr>
<td>Fibre</td>
<td>1.38bc±0.04</td>
<td>2.33c±0.1</td>
<td>0.31±0.14</td>
<td>1.52bc±0.06</td>
<td>1.72cd±0.05</td>
<td>1.82±0.06</td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>73.25±1.55</td>
<td>80.99±0.94</td>
<td>39.27±1.23</td>
<td>69.23±0.53</td>
<td>62.12±0.30</td>
<td>54.39b±0.54</td>
</tr>
<tr>
<td>Sugar</td>
<td>1.95±0.07</td>
<td>0.47±0.13</td>
<td>1.60bc±0.08</td>
<td>1.70±0.02</td>
<td>1.60b±0.12</td>
<td>1.46±0.06</td>
</tr>
<tr>
<td>Starch</td>
<td>75.91±2.33</td>
<td>81.27±1.00</td>
<td>47.40±2.43</td>
<td>73.14±0.46</td>
<td>70.61bc±0.78</td>
<td>68.25±0.43</td>
</tr>
</tbody>
</table>

Values are means of three determinations (n=3); values with different letter on the same row are significant (p<0.05). Sample A= 100% Wheat flour; B= 100% cassava flour; C= 100% soy-malt flour; D= 90% wheat flour+5% cassava flour + 5% soy-malt flour; E= 80% wheat flour +10% cassava flour + 10% soy-malt flour; F = 70% wheat flour+15% cassava flour + 15% soy-malt flour

Table 2. Physicochemical Properties cassava, wheat and soybean based composite flour

<table>
<thead>
<tr>
<th>Sample</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swelling capacity</td>
<td>195.00b</td>
<td>95.50a</td>
<td>350.50d</td>
<td>237.50c</td>
<td>255.00cd</td>
<td>257.00d</td>
</tr>
<tr>
<td>Solubility</td>
<td>185.0b</td>
<td>93.00a</td>
<td>345.0d</td>
<td>227.5c</td>
<td>245.0d</td>
<td>265.0e</td>
</tr>
<tr>
<td>Bulk Density</td>
<td>0.72d</td>
<td>0.53a</td>
<td>0.65bc</td>
<td>0.64b</td>
<td>0.67bc</td>
<td>0.71d</td>
</tr>
<tr>
<td>Water Absorption</td>
<td>206.5c</td>
<td>147.0b</td>
<td>93.00a</td>
<td>199.5c</td>
<td>190.5c</td>
<td>135.0b</td>
</tr>
<tr>
<td>pH</td>
<td>5.05b</td>
<td>6.79a</td>
<td>4.55a</td>
<td>6.61d</td>
<td>6.54ed</td>
<td>6.51c</td>
</tr>
</tbody>
</table>

Values are means of three determinations (n=3); values with different letter on the same row are significant (p<0.05). Sample A= 100% Wheat flour; B= 100% cassava flour; C= 100% soy-malt flour; D= 90% wheat flour+5% cassava flour + 5% soy-malt flour; E= 80% wheat flour +10% cassava flour + 10% soy-malt flour; F = 70% wheat flour+15% cassava flour + 15% soy-malt flour

Table 3. Mineral Content of cassava, wheat and soybean based composite flour

<table>
<thead>
<tr>
<th>Sample</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phosphorous</td>
<td>4.90b</td>
<td>34.00f</td>
<td>0.36e</td>
<td>7.22c</td>
<td>8.99d</td>
<td>11.20c</td>
</tr>
<tr>
<td>Magnesium</td>
<td>7.14b</td>
<td>1.30a</td>
<td>19.54f</td>
<td>9.25c</td>
<td>11.09d</td>
<td>12.69c</td>
</tr>
<tr>
<td>Potassium</td>
<td>1.72c</td>
<td>0.12a</td>
<td>0.06e</td>
<td>1.37b</td>
<td>1.28b</td>
<td>1.24b</td>
</tr>
</tbody>
</table>

Values are means of three determinations (n=3); values with different letter on the same row are significant (p<0.05). Sample A= 100% Wheat flour; B= 100% cassava flour; C= 100% soy-malt flour; D= 90% wheat flour+5% cassava flour + 5% soy-malt flour; E= 80% wheat flour +10% cassava flour + 10% soy-malt flour; F = 70% wheat flour+15% cassava flour + 15% soy-malt flour

Table 4. Vitamin Content of cassava, wheat and soybean based composite flour

<table>
<thead>
<tr>
<th>Sample (mg/100g)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin C</td>
<td>13.30c</td>
<td>2.26a</td>
<td>5.40b</td>
<td>11.25d</td>
<td>10.63cd</td>
<td>9.53c</td>
</tr>
<tr>
<td>Vitamin B1</td>
<td>0.032a</td>
<td>0.039b</td>
<td>0.046c</td>
<td>0.053d</td>
<td>0.061c</td>
<td>0.068d</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>1.14a</td>
<td>0.17a</td>
<td>9.75d</td>
<td>2.44b</td>
<td>2.99bc</td>
<td>3.93c</td>
</tr>
</tbody>
</table>

Values are means of three determinations (n=3); values with different letter on the same row are significant (p<0.05)
Table 5. Taste panel Score of biscuit made cassava, wheat and soybean based composite flour

<table>
<thead>
<tr>
<th>Sample</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>6.5c</td>
<td>5.1ab</td>
<td>4.5a</td>
<td>5.00bc</td>
<td>5.60b</td>
<td>5.60b</td>
</tr>
<tr>
<td>Taste</td>
<td>5.70c</td>
<td>4.00h</td>
<td>2.90a</td>
<td>5.00bc</td>
<td>4.80b</td>
<td>5.50c</td>
</tr>
<tr>
<td>Crumbliness</td>
<td>5.60d</td>
<td>4.10b</td>
<td>3.30a</td>
<td>4.80bc</td>
<td>4.70bc</td>
<td>5.10ed</td>
</tr>
<tr>
<td>Crispness</td>
<td>5.90c</td>
<td>4.50b</td>
<td>2.80a</td>
<td>5.10bc</td>
<td>5.00bc</td>
<td>5.60c</td>
</tr>
<tr>
<td>Hardness</td>
<td>6.10c</td>
<td>4.40b</td>
<td>2.50a</td>
<td>5.10bc</td>
<td>5.30c</td>
<td>5.40c</td>
</tr>
</tbody>
</table>

Values are means of three determinations (n=3); values with different letter on the same row are significant (p<0.05). Sample A= 100% Wheat flour; B= 100% cassava flour; C= 100% soy-malt flour; D= 90% wheat flour+5% cassava flour + 5% soy-malt flour; E= 80% wheat flour +10% cassava flour + 10% soy-malt flour; F = 70% wheat flour+15% cassava flour + 15% soy-malt flour.

Fig. 2. Biscuits baked from the flour mixes (Sample A= 100% Wheat flour; B= 100% cassava flour; C= 100% soy-malt flour; D= 90% wheat flour+5% cassava flour + 5% soy-malt flour; E= 80% wheat flour +10% cassava flour + 10% soy-malt flour; F = 70% wheat flour+15% cassava flour + 15% soy-malt flour)

contents of the flour mixes losses as the level of soybean flour and cassava flour rises, these were found to be within the range of 54.39 - 69.23% and 68.5 – 73.14% in respectively. It indicated that, the addition of the soybean flour may have contributed to the decreased in carbohydrate and starch contents of the flour mixes. The sugar content decreases with increasing level of soybean flour and cassava flour and was found to be within the range of 1.46 – 1.95%.

Physicochemical properties of composite flour

Table 2 shows the results for swelling ability, solubility, bulk density, water immersion capacity and pH. The swelling ability increases with increasing replacement of soybean malt and cassava flour, and it was found to be within the range of 237.50 - 257.00%. Sample B which is 100% cassava flour had the least and sample C (soybean malt flour) had the highest. Swelling capability is the volume of expansion of molecule in response to water uptake that it possessed until a colloidal suspension is achieved (Houssou and Ayernor, 2002). The increase in the swelling power of the composite flour which was detected as the level of cassava and soybean malt flour replacement increased was as a result of the higher swelling power observed in soybean flour in this work. The solubility of the flour mixes also increases with the addition of flour and cassava soybean and cassava flour C which is pure soybean flour has the maximum solubility (345%), but with the adding of wheat. Sample a flour, it was found to range between 227.5 -265.0%. The Bulk density also increases as a result of cassava and soybean flour substitution and all samples was found to be within the range of 0.53 -0.72 g/cm³. Cassava flour had the lowest (0.53 g/cm³) while wheat flour had the highest of 0.72 g/cm³. The particle size and the density of the food affect the bulk density of food materials. Bulk density is an important factor in food packaging. Low bulk density is desirable in infant feeding (Iwe and Onadipe, 2001) and low bulk density food is desired where packaging is a serious problem (Ikujenlola, 2008).

The water immersion capacity of the flour mixes was found to drop with increasing level of cassava and soybean flour. Sample A that is pure wheat flour has the maximum water absorption capacity of 206.5%. While sample C which is pure soybean flour has the least (93%). Decrease in water absorption ability was
detected as the level of soybean and cassava flour increases and it was found to range from 135.0 - 199.5%. Lower water absorption capacity could be due to absence of gluten in both cassava and soybean when associated with wheat flour. Iwe and Onadipe (2001) reported that capacity of flour to absorb water recovers dough-making potentials. Water absorption capacity of flour is suitable indicator of whether protein can be incorporated with the aqueous food sample B which is pure and when associated with wheat flour. Iwe and Onadipe (2001) reported that capacity of flour to absorb water recovers dough-making potentials. Water absorption capacity of flour is suitable indicator of whether protein can be incorporated with the aqueous food formulations, especially, those involving dough handling (Osungbaro et al., 2010). The pH of the flour sample was found to be within the range of 4.55 - 6.79. Sample C which is pure soybean flour has the least pH (4.55) and cassava flour the maximum. The flour mixes pH ranges from 6.51 – 6.61, which shows that the composite flours are not acidic. The flour can therefore be used to produce acceptable products for people suffering from stomach or pectic ulcer. The pH values of the composite flour in this work are similar to the pH values (5.73 to 6.33) reported by Bolarinwa et al., (2015) for malted sorghum-soy composite flour.

**Mineral content of composition of cassava, wheat and soybean flour mix**

The mineral content of cassava-wheat-soybean flour mixes is as shown in Table 3. Minerals are those inorganic elements that have a physiological function in the body (Bender, 2014). Phosphorous content of the flour mixes was observed to increase with increasing level of cassava and soybean flour. It was found to be within the range of 7.22 - 11.20 mg/100g. Sample C which is pure cassava flour has the maximum potassium content (34.00 mg/100g), while sample C that is pure soybean has the least (0.36 mg/100g). The Magnesium content was also found to increase with increasing level of cassava and soybean. It was found to be within the range of 9.25 - 12.69 mg/100g. Sample C which is pure soybean flour has the highest magnesium content, followed by sample A which is pure wheat flour while sample B which is pure cassava flour has the least magnesium content.

The potassium content on the other hand was found to decrease, with increasing level of cassava and soybean flour. It was found to range between 1.37 – 1.245 mg/100g. Sample A which is pure wheat flour has the highest potassium content, followed by sample E which is pure cassava flour while sample C which is pure soybean flour has the least potassium content. Bolarinwa et al., (2015) on the hand reported that phosphorous content of the composite flour (malted sorghum-soybean flour) decreases with increased soy flour substitution. This might be because soybean flour had lower phosphorus content as observed in our own study. Higher magnesium level observed in the flour mixes will helps in maintaining normal muscle and nerve functions and keeps the heart rhythm steady. In addition, phosphorus potassium and magnesium that are identified in the samples are all needed in repairing of worn out body cells and making of red blood cells (WHO, 1996).

**Vitamin content of cassava, wheat and soybean composite flour**

The result for vitamin content of composite flour shown in table (4) reported sample A which is pure wheat flour has the highest vitamin C content, followed by sample C, which is pure soybean flour, while sample B, which is pure cassava flour, has the least vitamin C content, but with substitution with cassava and soybean flour, vitamin C content was found to decrease, and was found to range from 11.25 -9.53 mg/100g.

The Vitamin B₃ content of sample C, which is pure soybean flour is highest followed by sample B, which is pure cassava flour, while sample A has the least vitamin B₃ content, but with substitution and increasing level of cassava and soybean flour, it was found to increase and within the range of 0.053 - 0.068 mg/100g. Also, the vitamin E content of the flour mixes was found to increase and it was within the range of 2.44 - 3.93 mg/100g. Sample C which is pure soybean flour, has the highest vitamin E content, followed by sample A which is pure wheat flour, while sample B which is pure cassava flour, has the least vitamin E content. Vitamins and their biological derivatives are crucial co-factors of many enzymes involved in vital metabolic processes and represent important dietary components essential for health (Langer and Lodge, 2014). Deficiency of riboflavin (vitamin B₂) is linked to cancer, anemia, cardiovascular disease, and various neurological disorders and developmental problems in humans (Powers, 2003). The soybean flour used in this study can be exploited as a basic raw material in composite flour to develop low cost nutritious functional food (biscuit) due to the higher level of vitamins E and B₂ found in it.

**Sensory evaluation of biscuits of composite flour**

Plate 2 showed the biscuits made from all the flour samples while the results found from organoleptic test are as shown in Table 5. From the table, in terms
of colour, sample E and F are not significantly different from each other. Sample B and D are also not meaningfully altered from each other. Sample A is rated higher while sample C is the least preferred. The taste for samples A, D and F are not significantly different from each other. Sample E and B ranked next while sample C is the least preferred.

For breakability, samples A, D, E and F are not significantly different from each other, sample B ranked next, while sample C is the least preferred. For freshness, all the samples ranked similar, but for sample C, followed by sample B. For hardness sample A is rated highest than all the other samples. Samples D, E and F are not significantly different from each other. The general acceptability shows that sample A which is pure wheat flour is the most acceptable followed by sample F. Samples D and E are not significantly different from each other, followed by sample B while sample C is the least preferred.

CONCLUSION

This study has exposed that biscuit could be made from cassava – wheat – soybean malt flour. The flour mixes were found to be high in protein, vitamin and mineral, which could be of help in avoiding protein-energy malnutrition in children. The high level of protein was because of soybean flour included. Also, cassava flour and soybean malt flour substitution in wheat flour for the assembly of baked product such as biscuit should be encouraged as this may lessen the price of biscuit especially on a large scale and make it more reasonable to the less privileged people in the society.

REFERENCES

5. Bender, A.D. 2015. Introduction to Nutrition and Metabolism. CRC Press, Taylor and Francis group. pg 307