Nutrient composition, physical and sensory properties of wheat-African walnut cookies

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Nutrient composition and sensory characteristics of wheat – African walnut cookies were determined. African walnut flour was prepared and used at varying replacement levels (5 - 20%) for wheat flour in the development of wheat-African walnut cookies. The increase in African walnut flour resulted in increase in the protein and fat contents of the composite cookies. The protein and fat contents ranged from 10.3 ± 0.2 - 13.0 ± 0.3 % and 14.4 ± 0.1 - 21.3 ± 0.1%, respectively. The control and 20% African walnut flour substitution had the highest and least values. The crude fibre, carbohydrate and ash contents of the cookies ranged from 3.1 ± 0.1 - 4.6 ± 0.1, 53.6 ± 0.0 - 60.9 ± 0.2 and 1.5 ± 0.1 - 1.7 ± 0.0 %, respectively while spread ratio varied from 0.96 to 1.40 for the 10 and 20% African walnut flour substitution. The level of likeness of the sensory attributes: appearance, taste, texture, flavour and overall acceptability of the wheat-African walnut cookies reduced with increase in African walnut flour substitution levels. African walnut flour could be used as a partial substitute for wheat flour at the levels of 5 to 15%, thus offering an alternative to diversifying the use of non-wheat flour.

Key words: African walnut flour, cookies, nutrient composition, physical and sensory properties.

INTRODUCTION

In developing countries legumes have high acceptability and utilization due to their importance as sources of dietary protein. The African walnut (Tetracarpidium conophorum) has a long history as food plant and is grown by peasant farmers across West African rain forest and India. In Nigeria it is found in the eastern and western parts (Ndie et al., 2010). African walnut is a perennial climbing shrub of 3 – 6 m long and needs a tree for support. The climber bears capsules which are greenish in colour when young and greenish/yellow when fully ripe; they contain four shelled seeds with brown shell and white/yellowish kernels. Its seeds are seasonal, take 4 - 6 months to mature and are found in the months of May and August (Odoemelam 2000, Ndie et al., 2010).

African walnut is a source of edible nuts and is traditionally eaten as nut after boiling (Akpuaka and Nwankwo, 2000). Tchiegang et al. (2001) reported that walnut kernels which are high in lipid content are eaten as nibbles in Cameroon. Studies on the nutritional qualities of the seed by Akpuaka and Nwankwo (2000), Edema et al. (2000), Odoemelam (2000), Oladiji (2007), states that T. conophorum seeds contain 26.3% protein and 46.5% oil (Linolenic acid 60%). A research by Edema et al. (2000) confirmed that the oil content varied between 55.75% and 61.62%. T. conophorum is a potential source of macro-minerals and trace elements needed by man due to its contents of calcium, sodium, potassium and phosphorus etc. Enwere (2009) showed that 3 - 9% of non-wheat flour can be used in snacks, such as, cake, cookies pie crust etc.

Walnut seed flour has a good potential for use as a functional ingredient agent in bakery products because of its high water absorption capacity, solubility, bulk density and rapid viscosity characteristics (Ndie et al., 2010). This shows that the flour is rich in protein and fat and can improve the pasting characteristic and can serve as a protein supplement. The oil from the nut could serve as a source of energy for growing seedlings and for the
formulation of wood varnish and vulcanized oil (Ajaiyeoba and Fadare, 2006). The chemical and functional characteristics of African walnut and the anti-microbial activity of the extracts of the oil reveal that the oil is edible and may be used as raw materials for soap, paint, food and other related industries (Oladiji et al., 2007; Enujiugha, 2003).

Cookies (soft type biscuits) are widely accepted and consumed in many developing countries (Giami et al., 2004). African walnut flour can be used in composite with other flours for the preparation of baked and fried products (Enwere, 2009). Composite flour is a mixture of different flours from cereals, legumes or root crops that is created to satisfy specific functional characteristics and nutrients composition. It refers to the process of mixing wheat flour with cereal and legume flours for making baked and fried food products like breads, biscuits, pie crust, buns and chin-chin. However the term may mean mixing of different flours from roots and tubers, legumes, cereals or other raw materials into a composite with wheat for many purposes. FAO (1990) reported that replacing wheat with 20% non-wheat flour for the manufacture of baked products would result in an estimated savings in foreign exchange of US $20 million for developing countries.

African walnuts are widely distributed in southern part of Nigeria (Aviara and Ajikashile, 2011). Non-conventional flours, such as, African walnut flour can present an alternative means of diversifying the use of non-wheat flour as it has the potential to increase farmer’s income by adding value to products, extend marketing, support food diversification and security and reduce wheat importation. The objective of this study, therefore, was to determine the nutrient composition, physical and sensory properties of wheat-African walnut cookies.

MATERIALS AND METHODS

MATERIALS

About 2 kg of fresh African walnuts (Figure 1) were purchased from Mile 3 market in Port Harcourt Rivers
State, Nigeria. Commercial wheat flour and the rest of the ingredients (i.e. fat, sugar, eggs, salt and flavouring) used in the cookie production were also purchased from the same market.

**METHODS**

**Production of African walnut flour**

African walnut flour was prepared as shown in Figure 2. The fresh African walnut seeds were washed thoroughly to remove sand, boiled for 30 – 45 mins, shelled and cut into slices to facilitate drying. The slices were then drained and oven dried at 70°C for 24 h. The dried slices were milled into flour and sieved using – 60 mm size mesh to obtain flour of uniform size. The flour was packaged in well labelled polyethylene bags and stored at room temperature until cookie preparation and analyses.

**Recipe formulation and cookies preparation**

Cookies were prepared with varying levels (0 – 20%) of wheat flour substituted with African walnut flour using the standard ingredients shown in Table 1. The method of McWatters et al. (2003) as described by Giami and Barber (2004) was used in cookie preparation. Briefly the
flours, sugar, baking powder and salt were hand mixed in a bowl. This was followed by addition of the fat and further mixing by hand to obtain a bread crumb-like mixture. The mixture was transferred into food processor (Homeluck). The liquid (egg and vanilla flavor) was then added and the mixture mixed at medium speed for 3 - 5 min to obtain the dough. The dough was manually rolled out on a floured board into sheets of uniform thickness of 4 mm and cut with a circular cookie cutter with diameter of 4 cm. The cut dough were transferred to baking trays lined with grease-proof paper and baked at 180°C for 10 - 15 mins in a domestic oven (Camara, Italy). Thereafter the cookies were cooled at room temperature and divided into 3 lots. The first was used for determination of physical characteristics immediately after cooling. The second lot was subjected to sensory evaluation after 24 h. The third lot was milled and used for chemical analyses.

**Proximate analysis**

The moisture, protein, carbohydrate, fat, crude fibre and ash content of the cookies were determined using standard analytical methods (AOAC, 2006). Moisture content was determined by drying 5 g of the milled cookies at 130°C for 1 h in an air oven (Sanyo Gallenkamp, Weiss Technik, West Midlands, UK). Ash was determined gravimetrically in a muffle furnace (Sanyo Gallenkamp, Weiss Technik, West Midlands, UK) at 500°C for 24 h. Fat was determined by exhaustive extraction of 0.5 g of sample with petroleum ether in a micro soxhlet extraction unit (Gerhardt, Bonn, Germany). Determination of protein was by Kjeldahl method. After distillation and titration, the nitrogen was corrected using a factor of 5.7. Carbohydrate was obtained by difference of moisture, protein, fat and ash from 100%.

**Determination of the spread ratio of the cookies**

The height, weight and diameter of the cookies were measured and the Spread Ratio calculated by dividing the cookies diameter by the height (Giami and Barber, 2004).

**Sensory analysis**

Untrained laboratory taste panelists consisting of 20 staff and students from the university community were selected to evaluate the sensory attributes of the cookies. The panelist was asked to assess the samples based on the following attributes: crust colour, taste, texture, crumb structure and overall acceptability. Panelists’ ratings were based on a 9-point hedonic scale with the degree of likeness of the product attribute expressed as follows: 1 - dislike extremely, 2 - dislike very much, 3 - dislike moderately, 4 - dislike slightly, 5 - neither like nor dislike, 6 - like slightly, 7 - like moderately, 8 - like very much and 9 - like extremely.

**Statistical analysis**

Results were analyzed statistically by the analysis of variance and difference between means separated. A completely randomized block design was used in this experiment. An F-test was used to determine significant differences at (P≤0.05). When analysis of variance revealed a significant effect, means were separated using Duncan’s New Multiple Range Test (DNMRT).

**RESULTS AND DISCUSSION**

**Proximate composition**

Table 2 shows the proximate composition of wheat-African walnut cookies. The moisture content was
Table 2. Proximate composition (%) of wheat- African walnut cookies.

<table>
<thead>
<tr>
<th>Samples (WF: AW)</th>
<th>Moisture</th>
<th>Protein</th>
<th>Fat</th>
<th>Crude Fiber</th>
<th>Carbohydrate</th>
<th>Ash</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (100: 0)</td>
<td>8.3±0.2</td>
<td>10.3±0.2</td>
<td>14.4±0.1</td>
<td>4.6±0.1</td>
<td>60.9±0.2</td>
<td>1.5±0.1</td>
</tr>
<tr>
<td>B (95: 5)</td>
<td>7.7±0.1</td>
<td>11.4±0.1</td>
<td>16.8±0.1</td>
<td>4.3±0.1</td>
<td>58.2±0.1</td>
<td>1.5±0.1</td>
</tr>
<tr>
<td>C (90:10)</td>
<td>7.1±0.1</td>
<td>12.1±0.1</td>
<td>18.0±0.2</td>
<td>4.5±0.1</td>
<td>56.6±0.2</td>
<td>1.6±0.1</td>
</tr>
<tr>
<td>D (85:15)</td>
<td>7.4±0.1</td>
<td>12.9±0.2</td>
<td>19.5±0.1</td>
<td>4.1±0.1</td>
<td>54.7±0.1</td>
<td>1.6±0.1</td>
</tr>
<tr>
<td>E (80:20)</td>
<td>7.8±0.2</td>
<td>13.0±0.3</td>
<td>21.3±0.1</td>
<td>3.1±0.1</td>
<td>53.6±0.0</td>
<td>1.7±0.0</td>
</tr>
</tbody>
</table>

Values are means ± standard deviation of triplicate determinations.
WF = Wheat flour; AW = African walnut flour.

Table 3. Physical characteristic of wheat-African walnut cookies.

<table>
<thead>
<tr>
<th>Samples (WF: AW)</th>
<th>Diameter (cm)</th>
<th>Height (cm)</th>
<th>Spread ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (100: 0)</td>
<td>3.15</td>
<td>2.7</td>
<td>1.16</td>
</tr>
<tr>
<td>B (95: 5)</td>
<td>3.20</td>
<td>2.3</td>
<td>1.39</td>
</tr>
<tr>
<td>C (90:10)</td>
<td>2.40</td>
<td>2.5</td>
<td>0.96</td>
</tr>
<tr>
<td>D (85:15)</td>
<td>3.20</td>
<td>2.3</td>
<td>1.39</td>
</tr>
<tr>
<td>E (80:20)</td>
<td>3.10</td>
<td>2.2</td>
<td>1.40</td>
</tr>
</tbody>
</table>

Values are means ± standard deviation of triplicate determinations.
WF = Wheat flour; AW = African walnut flour.

between 7.1 - 8.3 % for the control sample (wheat flour cookies and sample C (cookie samples with 10% African walnut substitution). The protein and fat contents varied from 10.3 - 13.0 and 14.4 - 21.3 %, with the 20% Walnut substitution (Sample E) and control (Sample A) having the highest and least values, respectively. The crude fibre, carbohydrate and ash contents of the cookies ranged from 3.1 - 4.6, 53.6 - 60.9 and 1.5 - 1.7%, respectively. Again, the 20% African walnut substitution (Sample E) and the control (sample A) exhibited the highest and least values.

The moisture content of the wheat cookies were significantly the highest. This could be due to the high moisture and water absorption capacity (13.3 and 140%, respectively) of wheat flour (Chandra and Samsher, 2013) as compared with that of African walnut flour (9.5 and 108% respectively) (Ndie et al., 2010). The moisture content of the wheat- African walnut cookies were comparable with reports on moisture contents of cookies and moisture contents below 10% are less likely to cause any adverse effect on the product (Okpala et al., 2011; Okpala et al., 2013).

The protein content of the control samples (i.e. 100% wheat flour) was the least, while those with walnut flour substitutions had higher protein contents. This signified that the addition of African walnut flour resulted in increase in the protein content of the cookies. This is not surprising as African walnut had been reported to be a rich source of protein (Ndie et al., 2010; Ekwe and Ihemeje, 2013). Enujiugha (2003) reported a protein content of 29.0% in freshly mature African walnuts. There has been similar report on the increase of protein content of baked products substituted with African bread fruit (Ihediohanma et al., 2009). The fat content of the cookies increased as the proportion of African walnut flour increased. This is in line with reports that African walnut has high oil content (Enujiugha, 2003; Edema et al., 2000; Ndie et al., 2010; Tichiegang et al., 2001; Ekwe and Ihemeje, 2013; Romoke, 2009). Tichiegang et al. (2001) reported that for its high lipid content, the nut is eaten in Cameroon as nibbles. The oil was reported to be an excellent source of omega 3 essential fatty acids; a special type of protective fat the body cannot manufacture (Romoke, 2009). The cookies produced with the walnut flour substitute could play a role in supplying the body with this essential fatty acid.

The carbohydrate contents in all test cookie samples were higher than the control. Ihediohanma et al. (2009) also reported a decrease in carbohydrate content of cakes with increasing substitution of African bread fruit flour. The fibre contents were within the recommended FAO/WHO (1994) level of not more than 5%.

Spread ratio

The physical characteristics of wheat-African walnut cookies are shown in Table 3. The diameter of Samples B, D and E with 10%, 20% and 40% African walnut flour substitution and the control were approximately 3 mm. The spread ratio could be seen as a function of the cookie diameter and height. Hence the spread ration of the control with the highest height of 2.7 mm was not the least rather Sample E with 10 % African walnut flour substitution had the lowest spread ratio. The height of
sample E was greater than the diameter. Higher spread ratios are desirable in cookies and reduction in spread ratios has been attributed to the hydrophilic nature of flours used in cookie production (Okpala et al., 2013).

### Sensory properties

Table 4 shows the sensory properties of the wheat/African walnut cookies. The control (wheat cookies) was rated significantly (P≤0.05) higher than the rest of the cookies for the attributes of appearance, taste, texture, flavour and overall acceptability. The 5% substitution with African walnut flour was not significantly (P ≤ 0.05) different from the control. Both the control and the 5% African walnut flour substitution were therefore the most preferred by the panelists. The rating was that of slight likeness. This suggested that the substitution level that was comparable to the traditional wheat cookie was 5% and as the substitution increased the level of likeness reduced.

### Conclusion

The proximate composition of the cookies in this study showed that African walnut flour can be used successfully as a partial substitute for wheat flour at a range of 5% to 15%. The cookies with 5% substitution of African walnut flour were preferable in terms of the sensory attributes and overall acceptability. However, additional studies are recommended to determine the actual nutritional quality, mineral and amino acid profiles and the storage stability of the wheat-African walnut cookies.

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### REFERENCES


Ndie EC, Nnamani CV, Oselebe HO (2010). Some physicochemical
characteristics of defatted flours derive from African walnut
\((Tetracarpidium conoformum)\): an underutilized legume, Pak. J. Nutr., 9
(9): 909 – 911.
of conorphorn nut \((Tetracarpidium conorphorum)\) flour, Int. J. Food Sci.
Okpala LC, Okoli EC (2011). Nutritional evaluation of cookies produced
from pigeon pea, cocoyam and sorghum flour blends. Afr. J.
Okpala L, Okoli E, Udensi E (2013). Physico-chemical and sensory
properties of cookies made from blends of germinated pigeon pea,
fermented sorghum, and cocoyam flours. Food Science and Nutr.,

Oladiji AT, Abodunrin TP, Yakubu MT (2007). Some physiochemical
characteristics of oil from \((Tetracarpidium conorphorum)\) null Arg, Hutch Dalz nut, Niger J. Biochem., 22(2): 93 – 98.
Romoke WA (2009). Nutritional value of walnut, Daily trust September
18, 2009, Nigeria.
Tchiegang C (2001). Chemical composition of oil from \(Tetracarpidium\)