PROXIMATE COMPOSITION AND SENSORY EVALUATION OF CAKE PRODUCED FROM WATER YAM (*Dioscorea alata*) A PANACEA FOR SURVIVAL AFTER RETIREMENT IN NIGERIA

1Chukwuka, Florence Obiageli, 2Omeneogo, Joy Enwelim & 3Nwahab, N.I
1 Department of Home Economics Education, Federal College of Education (Technical), Asaba
2Department of Vocational and Technical Education University of Benin, Benin City
Correspondence: florenceobia2013@gmail.com
enwelimjoy@gmail.com
ninwahab@yahoo.com

Abstract
Cake is a staple food product which has gained acceptance among consumer in the world today especially in Nigeria. Considering the present economic crises and recession with late payment of retirees in Nigeria, finding the alternative to the imported and very expensive wheat for survival after retirement will not be a bad idea. The study was carried out to examine the possibility of the use of water yam flour that grows easily in Nigeria for the production of cake for a maximum profit in Nigeria. This was done by analyzing the proximate composition and sensory evaluation of cake produced from water yam flour. The sample was subjected to sensory evaluation on colour, texture, taste, flavor and general acceptability a nine point hedonic scale was used. Twenty panelists were used for the sensory evaluation. Data was analyzed using mean and analysis of variation (ANOVA). Six code samples at 100% water yam flour, 100% wheat flour, 80%, 20%, 70%, 30%, 60%, 40%, 50%, 50% of water yam flour and wheat flour respectively. The instrument used was Sensory Evaluation Score Sheet (SESS) filled by the panelists during the testing session. They were evaluated for colour, taste, flavor, texture and general acceptability. Results obtained showed that cake and biscuits samples had majority of the respondents/subjects like slightly (LS) on the ground of taste, colour, flavor, texture and acceptability were accepted except for the case of texture of physical properties of cake to which they indicated neither like nor dislike (NLND). Proximate analysis was determined by food analysis (moisture, crude protein, ash, crude fibre and carbohydrate). Based on these findings, it was concluded that cake produced from water yam flour and wheat flour be recommended for food and pastries manufacturing companies for production and marketing. It is recommended that cake from water yam and wheat flour should be taken because it improves the nutritional value of confectionaries.

Keywords: Water yam, Cake, Proximate Composition, Sensory Evaluation, Retirement.

Introduction
Yams (*Dioscorea spp.*) are important tuber crop and staple food for millions of people in many tropical and subtropical countries. It has become a cash crop in countries along the coast of West Africa. Yams produce edible starchy storage tubers, which are of cultural, economic, and nutritional importance in the tropical and subtropical regions of the world. Generally, yam tubers are boiled, roasted, baked, or fried. However, in some regions, the tubers are boiled and then pounded to glutinous dough called "fufu." Cooked yam tubers or their products are usually eaten in association with protein-rich sauces. It has also gained importance in pharmaceutical industries. In this study however, a species of yam called water yam will be used.

Water yam (*Dioscorea alata*, L.), the most widely grown among the family of *Dioscorea* spp., is known to contain bioactive compounds such as dioscorine, diosgenin and water soluble polysaccharides. Dioscorine, water soluble storage protein of yam is reported to inhibit ACE (angiotensin converting enzyme) activity (Liu, Shang, Wang, Hsu & Hou, 2007) which plays an important role in management of hypertension when eaten whole (roasted or boiled). Dioscorin accounts for about 90% of the extractable water soluble protein found in *Dioscorea* species (*Dioscorea batatas*, *Dioscorea alata*, *Dioscorea pseudojaponica*), as estimated by immunostaining method (Hsu, Lin, Lee, Lin and Hou, 2012).
Diosgenin is a sapogenin steroid compound that can be absorbed through the gut and plays an important role in the control of cholesterol metabolism (Roman, Thawles & Coleman, 1995; Chapagain & Wiesman, 2005). It also shows estrogenic effect (Li, Mou, Lu, Sun, Lou, Yin & Zhou, 2012) and anti tumor activity (Moalic, Liagre, Corbiere, Bianchi, Dauca, Bordj & Beneytout, 2001). Water soluble polysaccharides are plant material that is not hydrolyzed by enzymes secreted by human digestive tract (Li et al., 2012). Other previous finding indicated that soluble fibers from water yam may increase digesta viscosity and the thickness of the unstirred layer in the small intestine. These soluble fibers show that gelling and thickening properties can decrease cholesterol and triglyceride absorption, reabsorb bile acids, increase fecal bile acid excretion and accelerate the synthesizing of hepatic cholesterol into bile salts (Yu, Lu, Chiang & Chiang, 2015). Water yam (D. alata) is an excellent source of starch, which provides calorific energy and protein three times more superior than the one of cassava and sweet potato and wheat flour (Adewale, Kehinde, Aremu, Popoola & Dumet, 2010; Evans & Boulter, 2014). It has low sugar content necessary for diabetic patients (Eneche, 2013). The flour made from water yam can be stored for 6 months or more in sealed containers. It can be used as a substitute for wheat flour in the following amounts: 100% in white sauces, 25-35%, 40- 50% in cookies, cakes and flat breads, and 15-20% in breads. Water yam flour could be marketed as a low cost alternative for imported wheat flour, especially for snack food and noodle producers (Peters & Wheatley, 1997). With these advantages incorporation of water yam flour could be useful in making cakes because of its shelf-life and nutritional quality. Cakes are soft bakery products produced by baking a batter containing flour, baking powders and beaten eggs with or without shortenings (Zambrano, Desinoy, Ormenese & Faria, 2014). According to the final products desired, other ingredients such as flavourings, nuts, chocolate and dried fruits are also included. Cakes are a major snack in the fast food industry and highlight of many celebrations. They are highly cherished by women and children. It is a complete food, rich in fat and proteins. There are literally millions of cake recipes and can be classified based on their accompaniment such as coffee cakes, occasion cakes or based, primarily on ingredients and cooking techniques (Eke, Achinewhu & Sanni, 2008). Cake may be small and intended for individual consumption such as queen cake while longer cakes are cut, sliced and served as part of a meal or social functions.

Zambrano, Desinoy, Ormenese and Faria (2014) reported the development of low fat of light cakes by substituting the fat with either quar or xanthan gums. Jyotsna, Sai Manohar, Indrani and Venkateswara (2007) reported the effect of substitution of wheat flour with protein concentrate (WPC) at the level of 10, 20 and 30% an egg replacer on the physical properties of the cake. Akubor (2014) reported the protein content, physical and sensory qualities of some Nigerian snack foods particularly cakes, chin- chi and puff-puff prepared from blends of cowpea, wheat flours and yam flours. Plant proteins are gradually gaining acceptance as food ingredients. Hence the study intends to produce cakes made from water yam flour to replace the products made from wheat flour. Considering the present economic crisis and recession in Nigeria, finding an alternative to the imported and very expensive wheat flour will not be a bad idea. Readily and available water yam flour therefore becomes a plus. It is against this background, the study examines proximate composition and sensory evaluation of cake produced from water yam (dioscorea alata) a panacea for retirement in Oshimili South Local Government Area of Delta State.

Statement of the Problem
A growing number of people seem to be switching to wheat free diets for good reasons. Though wheat is used for a wide range of products which include biscuits, bread, cakes, pastas, bagels, cereals, semolina but the nutritive value is questionable. Wheat that is imported into Nigeria is highly polished. The germ is completely removed during processing, leaving the wheat white and plain, which becomes worrisome. Though, manufacturing companies often tell consumers that the wheat flour has been fortified with some nutrients, but often times these appears not to be true. The effects of gluten in wheat such as fatigue, bloating, constipation and diarrhea, weight loss, intestinal damage, osteoporosis and anemia is enormous. Another problem is that the wheat flour is not readily available for use. On this backdrop, it becomes pertinent to try the water yam flour on cakes. Again after harvesting wheat, chemicals are again used for the storage process to protect the grains from moths and other insects. This may become a problem to the consumers, because the fumigation contains a toxic concentration of gas, meant to kill the pests. The
heat produced during processing of the grain destroys the bulk of vitamin E and other vital nutrients (Okpala & Ekwe, 2013). It has been noted that wheat flour used in baking of breads and other baked goods, is usually treated with bleaching agents to restore nutrients (protein, and vitamins), texture. Wheat is imported, thereby making it very expensive and out of reach for individuals, especially graduates who want to be self-employed to use it. On the other hand, water yam is locally and readily available and contain soluble fibers, and findings show that gelling and thickening properties can decrease cholesterol and triglyceride absorption, reabsorb bile acids, increase fecal bile acid excretion and accelerate the synthesizing of hepatic cholesterol into bile salts (Yu et al., 2015). It also shows esterogenic effect (Li et al., 2012) and anti-tumor activity (Moalic et al., 2001). Oko and Famurewa (2014) stated that water yam contains three times protein when compared to other species of yam and cereals. The use of water yam to produce bakeries such as cake may be nutritionally adequate for both young and old. Hence, the study sought to examine proximate composition and sensory evaluation of cake produced from water yam (Dioscorea alata) a panacea for retirement in Oshimili South Local Government Area of Delta State.

Purpose of the Study
The main purpose of this study is to examine proximate composition and sensory evaluation of cake produced from water yam flour (Dioscorea alata) a panacea for retirement in Oshimili South Local Government Area of Delta State. Specifically, the study sought to:

1. determine the proximate composition of cake produced from water yam flour.
2. determine the sensory evaluation of cake produced from water yam flour.

Research Questions
The following research question guided the study.

1. What is the proximate composition of cake produced from water yam flour?
2. What is the sensory evaluation of cake produced from water yam flour?

Materials and Methods

Materials: Water yam tubers (Dioscorea alata L) were purchased from a retail outlet in Asaba local market. Other baking ingredients such as eggs, sugar, baking powder, fat, milk and flavourings (vanilla essence) were also obtained from the same source. All equipment, reagents and chemical used were of analytical grade.

Production of water yam flour: The water yam tubers were washed, drained and peeled. The peeled tubers were sliced in 2cm thickness and dried in the hot air oven at 50 – 55°C for 24hr or air dried for 4 days. The dried chips was milled into flour with hammer mill and sieved with 600 μm mesh size. The flour samples or treatments (100% water yam flour (Control), 100% wheat flour, 100% water yam flour, 80% and 20%; 70% and 30%, 60% and 40%; 50% and 50% of water yam flour and wheat flour respectively) will be weighed sealed in polythene bag.

Production of Cake: Sugar butter was mixed according to the method as described by Bennion and Bamford (1983). The baking fat and granulated sugar were creamed together with the Kenwood mixer for 20 minutes until light. The eggs were beaten for 5 minutes with the homogenizer. Four additions (100 wheat flour (control) 100% water yam flour , 80% and 20%; 70% and 30%, 60% and 40%; 50% and 50% of water yam flour and wheat flour respectively) were made over a period of 7 minutes with good creaming between the additions. This was done to prevent the curdling of batter. After batter development of a soft velvety feel, the vanilla essence (flavouring) was added. These were then put in the oven and baked at temperature of 190°C for 15 minutes. The cakes were allowed to cool and then removed from the pan after 1hr. The cooled cakes were packaged in aluminum foils and kept in a shelf until required for sensory evaluation.

Procedure for Preparation of Cake with Water Yam flour

1. Sieve the flour
2. Grease pans (sprinkle with flour)
3. Cream fat and sugar
4. Add beaten eggs
5. Add flour gradually
6. Fold in eggs (add other ingredients)
7. Fill grease pans with mixture
8. Bake at temperature of 190°C for 15 minutes
9. Empty racks to cool
10. Serve

Determination of Proximate Composition of Cake after Baking
Crude protein, moisture content, fat, ash and crude fibre content of the cake was determined according
to the AOAC (2000) methods. The physical characteristics of the enriched cakes were measured using the method outlined by Zoulias, Oreopoulou and Kounalaki (2002) for fluted pumpkin cookies. Physical parameters include: height, weight, volume and specific volume. The queen’s cake volume was calculated using the cone equation below: $\text{Volume of cake (cm}^3) = \pi h (d^2 + db + b^2)$ where $d$ and $b$ are upper and lower diameters of cake. The specific volume was determined by dividing the cake volume by the weight.

**Sensory Analysis of Developed Cakes**

The samples were evaluated on the basis of colour, taste, flavor, texture and overall acceptability by a panel of twenty (20) trained panelists by using hedonic 9-point scale with 9 indicating “like extremely” and “dislike extremely”. The order of presentation of samples was randomized. Sachet water was provided to rinse the mouth between evaluations. The panelists were instructed to evaluate the coded samples for colour, taste, flavour texture and overall acceptability (Akinjaiyeju, 2000).

**Results**

The results dealt with detailed analysis of data obtained. The data were analyzed according to the research questions raised.

**Table 1: Proximate Composition of Cake produced from water yam floor**

<table>
<thead>
<tr>
<th>S/N</th>
<th>Moisture (%)</th>
<th>Protein (%)</th>
<th>Ash (%)</th>
<th>Fibre (%)</th>
<th>Carbohydrate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T&lt;sub&gt;1&lt;/sub&gt; 100%</td>
<td>30.25</td>
<td>8.76</td>
<td>1.86</td>
<td>0.10</td>
<td>51.49</td>
</tr>
<tr>
<td>T&lt;sub&gt;2&lt;/sub&gt; 100%</td>
<td>30.90</td>
<td>13.13</td>
<td>0.85</td>
<td>0.10</td>
<td>49.27</td>
</tr>
<tr>
<td>T&lt;sub&gt;3&lt;/sub&gt; 80/20</td>
<td>29.85</td>
<td>8.76</td>
<td>1.45</td>
<td>0.15</td>
<td>45.99</td>
</tr>
<tr>
<td>T&lt;sub&gt;4&lt;/sub&gt; 70/30</td>
<td>39.85</td>
<td>8.32</td>
<td>1.40</td>
<td>0.15</td>
<td>42.73</td>
</tr>
<tr>
<td>T&lt;sub&gt;5&lt;/sub&gt; 80/40</td>
<td>34.15</td>
<td>8.32</td>
<td>1.40</td>
<td>0.10</td>
<td>48.83</td>
</tr>
<tr>
<td>T&lt;sub&gt;6&lt;/sub&gt; 50/50</td>
<td>41.30</td>
<td>8.32</td>
<td>1.20</td>
<td>0.50</td>
<td>43.48</td>
</tr>
</tbody>
</table>

Table 1 explains the proximate analysis result of cake samples. For sample T<sub>1</sub> with 100% water, the cake contained 30.25% of moisture, 1.86% of ash, 7.55% fat, 0.10% of fibre, 8.96% of protein, and 51.49% of carbohydrate. Sample T<sub>2</sub> with 100% wheat flour had a moisture of 30.90%, 0.85% ash, 5.75% of fat, 0.10% of fibre, 13.13% of protein, and 49.27% of carbohydrate. The sample T<sub>3</sub> 80/20 had a moisture of 29.85%, ash of 1.45%, fat of 13.80%, 0.15% of fibre, protein of 8.76%, and carbohydrate of 45.99%. The sample T<sub>4</sub> 70/30 had a moisture of 39.85%, ash constituted 1.40%, fat was 7.55%, fibre was 0.15%, protein of 8.32% and carbohydrate of 42.73%. The sample T<sub>5</sub> 80/40 constituted a moisture of 34.15%, 1.40% of ash, 7.20% fat, fibre of 0.10% protein of 8.32% and carbohydrate of 48.83%. The sample T<sub>6</sub> 50/50 had a moisture of 41.30%, ash of 1.20%, 5.20% of fat, 0.50% of fibre, 8.32% of protein and 43.48% of carbohydrate.

**Table 2: Sensory Evaluation of the sample cakes.**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>CHA</th>
<th>CHB</th>
<th>CHC</th>
<th>CHD</th>
<th>LSD (P&lt;0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour</td>
<td>6.60&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.60&lt;sup&gt;b&lt;/sup&gt;</td>
<td>5.15&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.25&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.40</td>
</tr>
<tr>
<td>Texture</td>
<td>6.65&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.25&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.80&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.4&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.38</td>
</tr>
<tr>
<td>Taste</td>
<td>6.00&lt;sup&gt;c&lt;/sup&gt;</td>
<td>4.35&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.25&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.75&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.98</td>
</tr>
<tr>
<td>Flavor</td>
<td>5.35&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.85&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.10&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.45&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.85</td>
</tr>
<tr>
<td>General Acceptability</td>
<td>6.15&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.65&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.55&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.25&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.18</td>
</tr>
</tbody>
</table>

Table 2 summarizes the mean sensory scores for the sample cakes. Sample CHA was rated highest, followed by sample CHB, while CHD was rated least for all the attributes.
The findings on the proximate composition of water yam flour showed that water yam (Dioscorea alata, L.) which is the most widely grown among the family of Dioscorea spp. Is known to contain bioactive compounds such as dioscorine, diosgerin and water soluble polysaccharides. Its compound, dioscorine, inhibits ACE (angioterisin converting enzyme) activity (Liu et al; 2007), which plays an important role in management of hypertension when eaten whole (roasted or boiled). The findings as relates to the proximate composition of the acceptable level of water yam flour for cake showed that research findings has it that water yam contains three times protein when compared to other species of yam and cereals. The use of water yam to produce pastries such as cakes may be nutritionally adequate for both young and old (Oko & Famurewa, 2014).

Findings on the sensory properties of blends of water yam and wheat flour blends for cake showed an average mean of 5.93 which is greater than the benchmark mean of 5.00. Water yam flour could be marketed as a low cost alternative for important wheat flour, especially for snack food and noodle producers (Peters & Wheatley, 1997). With these advantages, incorporation of water yam flour could be useful in making cakes because of its shelf-life and nutritional quality. Cake is a conventional snack mostly produced from wheat flour with other ingredients such as sugar, margarine, salt, baking powder. Cake is high in carbohydrate, and deficient of nutrients because of its polished nature, therefore, improving protein content of such highly-consumed snack among school-aged children cannot be overemphasized. Wheat flour like other cereals is limited in lysine and tryptohan and rich in sulphur containing amino acids, which the reverse is the case for water yam (Ene-Obong & Carnovale, 2012).

Discussion of Findings
Based on the findings of organoleptic properties of water yam flour with best sensory properties of cake, study showed that Diosoria accounts for about 90% of the extractable water, soluble protein found in Dioscorea species (Dioscorea batatas, Dioscorea alata, Dioscorea pseudojaponica), as estimated by immunostaining method (Hsu et al; 2012). Diosgenin is a sapogenin steroid compound that can be absorbed through the gut and plays an important role in the control of cholesterol metabolism (Roman et al; 1995; Chapagain & Wiesman, 2005). It also showed esterogenic effect (Li et al, 2012) and anti-tumor activity (Moalic et al; 2001). Water yam contains soluble fibers, proteins (sufficient in essential, amino acids), vitamins, thereby making its use in producing cake to be nutritionally adequate for people of all ages.

The findings on the proximate composition of water yam flour showed that water yam (Dioscorea alata, L.) which is the most widely grown among the

<table>
<thead>
<tr>
<th>S/N</th>
<th>Height (cm)</th>
<th>Volume (cm³)</th>
<th>Specific Volume (cm³)</th>
<th>Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁ 100%</td>
<td>5.5</td>
<td>333.50</td>
<td>5.44</td>
<td>61.65</td>
</tr>
<tr>
<td>T₂ 100%</td>
<td>3.8</td>
<td>309.49</td>
<td>4.54</td>
<td>67.69</td>
</tr>
<tr>
<td>T₃ 80/20</td>
<td>3.4</td>
<td>258.40</td>
<td>4.08</td>
<td>63.33</td>
</tr>
<tr>
<td>T₄ 70/30</td>
<td>3.8</td>
<td>427.61</td>
<td>4.48</td>
<td>95.39</td>
</tr>
<tr>
<td>T₅ 80/40</td>
<td>3.5</td>
<td>244.16</td>
<td>3.27</td>
<td>74.76</td>
</tr>
<tr>
<td>T₆ 50/50</td>
<td>4.3</td>
<td>425.51</td>
<td>4.77</td>
<td>88.81</td>
</tr>
</tbody>
</table>
marketing. This would aid in boosting Nigeria’s economy and add varieties of cake production in the market.

**Recommendations**

Based on the findings of this study, the following recommendations were made:

1. It is recommended that cake from water yam and wheat flour should be taken because it improves the nutritional value of confectionaries.
2. The nutritionists should introduce it to people who actually need it to improve their health status.
3. The state government should introduce it to the masses through seminars, advertisement, workshops and publications.

**References**


Commonly cultivated in the South-Eastern Nigeria.


