INTRODUCTION

Over the years, the demand for nutritive and energy giving confectionery has been on the increase in Nigeria. Biscuits are a rich source of fat and carbohydrate, hence are energy giving food, and they are also good sources of protein and minerals (Olaoye et al., 2007). Biscuits are ready-to-eat, convenient and inexpensive food products, containing digestive and dietary principles of vital importance (Olaoye et al., 2007) and are sold at every corner of the street in the country. Biscuits are made from cereals, sweeteners, shortenings and leavening agents. Biscuits may be classified either by the degree of enrichment and processing or by the method adopted in shaping. Based on the enrichment criterion, biscuits may be produced from hard dough, soft dough or from battars (Agu et al., 2007). The nutritional content however varies with the type of flour used. Soft wheat flour is the suitable flour for biscuit-making. This is due to its content of gliadin (a prolamin) and glutamin (glutelin) which undergoes hydration in the presence of water, salt and sugar. This protein form a visco-elastic matrix known as gluten, being responsible for the rising nature of dough or permit substantial increase in the volume of baked product of dough and its gas retention capacity (Okaka, 1997).

Nigeria being one of the tropical countries cannot grow wheat in commercial quantity due to its climatic condition. Only 3% of the country’s total consumption of wheat can be produced locally (Agu et al., 2007), therefore the industry can only survive by utilization of the available local food sources which can partially or completely substitute wheat in the production of biscuit without adversely affecting the quality of the product (Kent, 1984). Banana is the world’s most popular fruit, the world’s largest herb with attendant high medicinal properties (Kachru et al., 1995). Banana is a well-known source of carbohydrates and dietary fibre. Bananas have long been recommended as dietary supplements for individuals suffering from digestive disorders (FAO, 1990). According to Mota et al. (2000), green banana fruit contain higher hemicelluloses content (6.08%) than most fruits and vegetables. Apart from dietary fibre, green banana contain higher amount of essential minerals such as potassium and various vitamins such as A, B1, B2, and B3.

Banana flour is made from the starchy green bananas. The flour is very fine and is very useful for its moisture absorbing and holding properties (Kachru et al., 1995). It is gluten free and can be used to make biscuit (Zoulinus et al., 2002). Banana flour contained some percentage of starch hence, used for the formulation of nutritious weaning mixes and complementary foods. Cocoyam contribute significant portion of the carbohydrate content of the diet in many regions in developing countries and provide edible starchy storage corms and cormels (Sanful and Darko, 2010). Although they are less important than other tropical roots such as yam, cassava, and sweet potato, they are still a major staple in some parts of the tropics and sub-tropics (Ojinaka et al., 2009). Cocoyam has nutritional advantage over root crops and other tuber crops (Lyonga and Nzietechueng, 1986). It has more crude protein than other roots and tubers and its starch is highly digestible because of the small size of the starch granules; and it also contains calcium, phosphorus, dietary fibre, vitamins A, B, and C in substantial quantities (FAO, 1990, Ubbor and Kanu, 2012).
The high content of calcium oxalate crystals (780mg per 100g) in some species of cocoyam, has been implicated in the acridity or irritation caused by cocoyam. Oxalates tend to precipitate calcium and make it unavailable for use by the body (Sanful and Darko, 2010). The acridity of high oxalate cultivars of cocoyam can be reduced by peeling, soaking, grating and fermenting during processing. Cocoyam is used essentially the same way as yam, although it is not considered as prestigious as yam. Its flour has the added advantage that, it is highly digestible and so is used for invalids and as an ingredient in baby foods.

Satisfactory biscuits have been made from composite flour through a blend of wheat flour with other cereals and root crops. According to Sanful and Darko (2010), flours milled from other crops such as maize, millet, sorghum, cassava, potato, rice, etc. has been added to wheat flour to improve the use of the local crops and reduce the cost of wheat importation. This is practiced mostly in tropical countries where the soil and climate are not favourable for commercial large-scale production of wheat. Although wheat flours are mostly used for biscuit making the use of composite flours has been reported by many researchers. Olaoye et al. (2007) and Agu et al. (2007) investigated the supplementation of breadfruit flour in wheat flour for biscuit making. In their report up to 15% supplementation had no significant difference in all sensory attributes when compared with whole wheat biscuits. Also, Mepbah et al. (2007), produced composite bread and biscuits from mixed flours of wheat and plantain, and also obtained a successful substitution of upto 30% supplementation of plantain flour. A research with jackfruit seed flour supplementation in biscuit making carried out by Edima-Nyah and Nwokocha (2015) also showed success at 15% supplementation. The objective of this work was therefore to formulate, produce and evaluate the quality of Biscuits from wheat-banana-cocoyam composite flour blends.

MATERIALS AND METHODS

Source of materials

Red cocoyam (*Xanthosoma sagittifolium*) cormels and mature banana (*Musa sapientum*), were purchased from Akpan Andem Market, Uyo, Akwa Ibom State, Nigeria. The wheat flour (Flour Mills product) and all other ingredients used in the biscuit recipe were also purchased from the same market.

Production of banana flour

Banana flour was produced according to the method described by Ijarotimi (2008). Fresh unblemished mature green bananas were de-fingered, steamed for about 10 minutes to decrease sticky sap, improve flour colour and facilitate peeling. The steamed bananas were peeled with a stainless steel kitchen knife and sliced to about 0.5cm thick pieces, soaked for 15minutes in sodium metabisulphite solution (to reduce browning), and drained through perforated stainless sieve. The drained slices were placed on tray, dried in an oven at 65 °C for 24hours and milled. The milled sample was sieved through 0.4mm wire mesh screen to flour of fine texture. The resulting flour was stored in an airtight container at room temperature.

Production of cocoyam flour

The method of Ubbor and Kanu (2012) was modified and used in cocoyam flour production. The cormels of red cocoyam (*Xanthosoma sagittifolium*) were manually peeled, sliced into about 1.4 mm thickness with a stainless steel kitchen knife, and blanched in boiling water for 5 minutes. The blanched cocoyam slices were drained using a perforated stainless steel sieve and oven dried at 65 °C for 24 hour. The slices were milled, sieved through 0.4 mm sieve to flour of fine texture and stored in an airtight container at room temperature.

Blend formulation

The flours were blended as shown in Table 1 to obtain six (6) composite samples. The flours were mixed using a Kenwood food mixer (KN 201, England) to ensure a homogeneous mixture of the sample. They were packaged in airtight polyethylene bags and stored at room temperature.

Production of composite biscuit

The recipe used to produce the composite biscuits is as described by Dogan (2006). Equal amount of sugar, shortening, salt, baking powder and water were used. Biscuits were produced from the six blend formulations. The ingredients were weighed, and mixed until homogeneous mixture was obtained. Kneading was carried out to develop the dough with a dough mixer for 30 minutes. The dough was rolled on a flat table to desired thickness, cut to desired shapes and sizes, arranged in greased trays, and baked at 200 °C for 15minutes. The hot baked biscuits were allowed to cool, packaged and stored at room temperature for subsequent analysis.

Proximate analysis of biscuits

The moisture, ash, crude fibre, crude fat, and crude protein contents of the biscuits produced were determined using the method of AOAC (1990). The carbohydrate content was determined by difference.

Sensory evaluation of biscuits

The sensory attributes, including appearance, taste, texture, mouth feel (crispiness), aroma, and overall acceptability, of the six biscuit samples were evaluated using a nine (9) point Hedonic scale ranging from 1 (extremely dislike) to 9 (extremely like) (Iwe, 2002). A 20-member semi-trained panellist drawn from the Department of Food Science and Technology, University of Uyo, Uyo were used for evaluation.
The fat content of the biscuit produced ranged from 7.52 ± 0.02% to 8.66 ± 0.02% (Table 2), with sample D (10:50:40-w:b:c) having the lowest and sample B (10:70:20-w:b:c), the highest value. All the samples (A - F) were significantly (p<0.05) different from each other in their moisture content. Agu et al. (2007) reported close values (7.2±0.54 – 8.4±0.67%) for wheat-breadfruit biscuits. The biscuit samples generally had low moisture contents, which implied that the samples could have an extended shelf life since the moisture content of a food affects its stability and overall quality (Samuel and Otegbayo, 2006; Usman et al., 2015). The crude protein content of the biscuit samples ranged from 3.9±0.01% to 10.5 ± 0.02%. Sample F (0:50:40-w:b:c) had the highest value, while sample A (100:0:0-w:b:c) – the control – had the highest value. Sample B (10:70:20-w:b:c) and D (10:50:40-w:b:c) were not significantly different (P>0.05) from each other, however, they differed significantly (p<0.05) from other biscuit samples (A, C, E and F). The decrease in protein content could be as a result of reduction in or absence of wheat from the biscuit samples. crude protein content decreased with increase in cocoyam and banana proportion in the biscuit samples. The protein plays a part in the organoleptic properties of the samples in addition to being a source of amino acids (Usman et al., 2015).

The carbohydrate content of the biscuits samples ranged from 66.2 ± 0.23 to 73.8±0.05%, where sample A (control) had the lowest and F (0:50:50-w:b:c) had the highest value. Biscuit samples B, C, and E were not significantly different (p>0.05) to one another, but however differed significantly (p<0.05) from all other samples (A, D, F). Agu et al. (2007) reported carbohydrate content of 56.38% to 73.21% in biscuits made from wheat-African breadfruit seeds composite flour. According to Messiain (1992), the lower the protein, fat and ash content, the higher the carbohydrate content of a food. Significant differences (p<0.05) existed on the fat content of the various biscuits. The fat content ranged from 7.37±0.01 to 10.90 ± 0.01% with increase in wheat proportion. Olaoye et al. (2007) reported higher fat contents (24.15 – 26.5%) for wheat – breadfruit flour biscuits. The higher values could be as a result of higher amounts of wheat in the composite flour and also the quantity of fat applied during biscuit production. Fat plays a significant role in the shelf life of food products and as such, relatively high fat content could be undesirable in baked food products. This is because fat can promote rancidity in foods, leading to development of unpleasant and odorous compounds (Ihekforonye and Ngoddy, 1985). Dietary fat that provides essential fatty acids has been shown to enhance the taste and acceptability of foods, slows gastric emptying and intestinal motility thereby prolonging satiety and facilitating the absorption of liquid soluble vitamins (Usman et al., 2015).

Ash content varied significantly (p<0.05) among the various biscuits produced and range from 2.8 ± 0.01% to 3.9 ± 0.02%. The ash content increased with increase in banana and cocoyam proportion of the composite flour and decrease in wheat flour. Agu et al. (2007) reported a lower ash content of 0.99 – 1.13%, while a higher value of 3.09 – 6.78% was reported by Olaoye et al. (2007) for wheat-breadfruit biscuits. Ash is a non-organic compound containing mineral content of food and nutritionally aids in the metabolism of other organic compounds such as fat and carbohydrate (McWilliam, 1978). The ash content gives an overall estimate of the total mineral elements present in the food (Usman et al., 2015). Crude fibre content of all the biscuit samples were significantly different (p<0.05) and ranged from 1.88 ± 0.03% to 2.68 ± 0.03%. Sample A (control) recorded the lowest while sample F (0:50:50-w:b:c) recorded the highest crude fibre content. The differences may be due to the flour formulations. Olaoye et al. (2007) reported 1.03 – 4.98% for wheat-breadfruit composite biscuit with 100% wheat flour also having the lowest value (1.03%). Crude fibre is known to aid the digestive system of human (Ihekforonye and Ngoddy, 1985). Fibre is important for the removal of waste from the body thereby preventing constipation and many other health disorders. Consumption of vegetable fibre has been shown to reduce cholesterol level, risk of
coronary heart diseases, colon and breast cancers and hypertension, enhance glucose tolerance and increase insulin sensitivity (Samuel and Otegbayo, 2006; Usman et al., 2015).

Table 2: Proximate composition (%) of the Biscuits produced from banana – cocoyam composite flour blends

<table>
<thead>
<tr>
<th>Biscuit sample*</th>
<th>Moisture content</th>
<th>Protein</th>
<th>Fat</th>
<th>Ash</th>
<th>Crude</th>
<th>CHO</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>8.43 ± 0.01d</td>
<td>10.52±0.02c</td>
<td>10.90 ± 0.01f</td>
<td>2.85 ± 0.01b</td>
<td>1.88±0.03a</td>
<td>66.20 ± 0.23a</td>
</tr>
<tr>
<td>B</td>
<td>8.66 ± 0.02f</td>
<td>5.95±0.04b</td>
<td>10.13±0.04d</td>
<td>3.14 ± 0.01d</td>
<td>2.15±0.01d</td>
<td>68.62 ± 2.32b</td>
</tr>
<tr>
<td>C</td>
<td>7.73 ± 0.06b</td>
<td>6.21±0.01c</td>
<td>10.58±0.01e</td>
<td>3.26±0.01c</td>
<td>2.26±0.01c</td>
<td>70.02 ± 0.06b</td>
</tr>
<tr>
<td>D</td>
<td>7.52 ± 0.02a</td>
<td>5.92±0.03b</td>
<td>8.78±0.02b</td>
<td>2.37 ± 0.06a</td>
<td>2.05±0.02c</td>
<td>73.33 ± 0.01c</td>
</tr>
<tr>
<td>E</td>
<td>8.51 ± 0.01c</td>
<td>6.27±0.01d</td>
<td>9.95±0.00ce</td>
<td>3.07±0.01c</td>
<td>2.01±0.01b</td>
<td>70.22 ± 0.01b</td>
</tr>
<tr>
<td>F</td>
<td>8.27 ± 0.01c</td>
<td>3.86±0.01a</td>
<td>7.37±0.01a</td>
<td>3.99±0.02f</td>
<td>2.68±0.03f</td>
<td>73.84 ± 0.05c</td>
</tr>
</tbody>
</table>

Means with different alphabets in the same column are significantly different at p<0.05

Aroma is an important parameter of food (Iwe, 2002). The result of the aroma showed that sample A (100:0:0-w:b:c) was not significantly different (p>0.05) from samples B (10:70:20-w:b:c), C (20:60:20-w:b:c), D (10:50:40-w:b:c), E (20:40:40-w:b:c), F (0:50:50-w:b:c) composite biscuit but were different from sample D (10:50:40–w:b:c). The result of crispiness showed that sample A was not significantly different (p>0.05) from samples B, C, D, E, but significantly different (p<0.05) from sample F. The taste of sample A (100% wheat control) was significantly different (p<0.05) from all other biscuit samples which are composite samples. However, samples B, D, E and F were not significantly different (>0.05) from one another, but significantly different from A and C.

CONCLUSION
In this study, it was observed that the quality of biscuits could be improved, in terms of crude fibre, ash and carbohydrate contents, with use of banana and cocoyam flour. The whole-wheat biscuit (sample A) was most acceptable and significantly different from banana – cocoyam composite biscuits in all sensory attributes except appearance. This is because it is an existing product, while other biscuit sample are newly formulated, which the ‘tasters’ are not familiar with. However, the hedonic score were encouraging (all ranging within 7 point) on
product acceptability. It is believed that regular supply, publicity and introduction of health claims (in terms of the importance of mineral ash and dietary fibre to the human health), improvement of production strategy and quality may enhance product acceptability.

REFERENCES


Iwe, M. O. 2002. Handbook of Sensory Methods and Analysis. PROJOINT Communications Services Ltd, Enugu, pp70-72.


