JHER Vol. 20, September 2014, pp. 100-108

Sensory Evaluation and Proximate Composition of Snacks Produced from Composite Flour of *Dioscorea alata* and *Telfairia occidentalis* Seeds

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Abstract

The purpose of this research was to develop snacks (cuts of chin chin and strips of chin chin) from composite flour of *Dioscorea alata* tubers and defatted *Telfairia occidentalis* seeds and to test the snacks for acceptability. The study adopted an experimental design. *D. alata* tubers and *T. occidentalis* seeds were processed into flour using different methods. Cuts of chin chin and strips of chin chin were produced from composite flour of *D. alata* and defatted *T. occidentalis* seeds. Proximate composition of these samples was determined. The samples were also subjected to sensory evaluation on: (colour, texture, taste, flavour and general acceptability). A nine-point hedonic scale was used. Twenty panelists were used for the sensory evaluation. Data was analysed using means and analysis of variance (ANOVA). Incorporating defatted *T. occidentalis* seeds at 10%, 20% & 30% resulted in an increase in protein content of the snacks. For cuts of chin chin, the protein content ranged from (5.98%) to (6.55%) and for strips of chin chin (5.10%) to (6.82%). Result of sensory evaluation showed that the control (100% wheat flour) was most preferred followed by samples with 90% *D. alata* flour and 10% *T. occidentalis* seeds flour for both products. It was concluded that flours from *D. alata* tubers and *T. occidentalis* seeds at a ratio of 90:10 could be used for chin chin production.

Keywords: Snacks, Composite flour, *Dioscorea alata* tubers, *Telfairia occidentalis* seeds, Wheat flour

Introduction

Most tropical countries are faced with protein – energy malnutrition as a result of increasing population and enhanced dependence on cereal and tuber based diet. It is estimated that, about 800 million malnourished people exist in some of the least developed countries, mostly in sub Saharan Africa (Food and Agricultural Organization, 2006). In countries such as

Nigeria animal products representing high concentration and quality of protein are either too expensive or simply unaffordable thus, increasing the dependence on cereal grains, roots and tuber crops (Barber, Beleya, Eke and Owuno, 2010). Tuber crops are eaten in several ways and in most cases; they are milled into flour and utilized in preparing various items. *Dioscorea alata* is a tuber crop widely cultivated in Nigeria, it is used in the production of various food items such as pounded yam, snacks etc. (2010, Adams). Snacks are small meals eaten between the main meals in order to maintain health, while satisfying appetite. Snacks are often smaller than the regular meals and are designed to be portable, quick and satisfying then prepared meals. Many snacks are low in nutritional value. However, in recent times, snacks are being fortified as to provide consumers with products that provide the much needed nutrients.

Snacks are mostly produced from wheat flour. However, Opkala and Okoli (2011) noted that, in many regions of the world, wheat flour is unavailable or uneconomical. Thus in such countries like Nigeria, they have to rely on importation of wheat flour to sustain the production of snacks or exclude wheat product from the diet. Studies revealed that, the demand for snacks and pastry product is on the increase and the cost of the products has become very expensive (Sanful and Darko, 2010). Thus, to sustain the consumption of snacks, and reduce the importation of wheat flour, there is therefore a need to source for alternative source of flour as substitute for wheat flour or partially replace wheat flour in the production of snacks. The replacement of wheat flour requires the development of an adequate substitute in terms of functionality, cost and availability. Attempts have been made to produce flour from other cereals apart from wheat as well as composite flour from different food categories.

Flour produced from either cereals, legumes and tubers only will have a nutritional value inferior to those produced from a combination of cereals legumes or tubers (Barber et al, 2010). In selecting the components to be used in composite flour blends, the material should be readily available culturally acceptable and provide an increased nutritional potential (Akobundu, Ubbaonu and Ndupud, 1998). According to FAO (1995), composite flours produced from legumes have the advantage of improving overall nutrition. Therefore, composite flour produced from legumes and tubers will have high protein content and will also have high calorific value (Chinma, Ingbian and Akpapaunam, 2007). The production of composite flour from different food crops will result in flours that can be used as a replacement for wheat in the production of snacks. Awan, Rehman, Salim-ur, Rehman, Ismail and Hashmi (1995) noted that, composite flours are also advantageous in the sense that, the inherent deficiency of essential amino acids such as lysine in wheat flour is supplemented from other food crops such as legume. Barber *et al* (2010) stated that, to improve the nutritional value of cereal-based diets, legumes should be used to fortify them. The nutrient content of legumes makes them natural complements to cereal-based diets. Legumes have also been recognized as the second most valuable plant source for human and animal nutrition (Sanni, Adebowale and Yusuf, 2006). Legumes include soybean (*Glycine max*), cowpea (*Vigna unguiculatta*), African Yambean (*Sphenostylis stenocarpa*), fluted pumpkin seed (*Telfairia occidentalis*) etc (Sanni *et al*, 2006). According to the authors, *Telfairia occidentalis* seed is one of the most important food legumes in Africa and south East Asia. It is the most widely grown legume and one of the cheapest sources of plant protein (Chido, 2007).

Studies have shown improvement in protein content of several cereal and tuber foods supplemented with legume such as bambara groundnuts, sesame seeds and fluted pumpkin seeds (Giami and Barber, 2004; Alobo 2001). Barber *et al* (2010) reported that addition of 50 percent cowpea to malted sorghum resulted in an increase in protein, ash, and crude fibre content of sorghum cowpea blends. Snacks have been produced from composite flours of tubers and cereals. Olapade and Ogunade (2014) produced crunchy snacks from potato and maize composite flour with high acceptability. Abayomi, Oresanya, Opeifa and Rasheed (2013) evaluated the quality of cookies produced from sweet potato and fermented soybean flour. Their findings revealed that cookies with 20% soybean substitution had the highest mean for overall acceptability and was nutritionally superior to the other samples. The findings of Abayomi *et al* (2013) buttress the fact that composite flours of tubers and legumes have a high nutritional quality. Thus enrichment of *Dioscorea alata* flour with *Telfairia occidentalis* seeds flour will improve the nutrient quality of the flour and products from the composite flour will have a high nutritional quality. However, there is no published work on the nutrient composition and other characteristics of snack (Chin chin) produced from composite flour of *Dioscorea alata* and *Telfairia occidentalis* seeds flour.

Purpose of the study

The purpose of this research was to develop snacks (cuts of chin chin and strips of chin chin) from composite flour of *Dioscorea alata* tubers and defatted *Telfairia occidentalis* seeds and to test the snacks for acceptability. Specifically the study determined:

(1) The proximate composition: moisture, ash, fat, protein, carbohydrate and crude fibre of the products
(2) Determined the acceptability of the products based on colour, texture, taste, flavour and general acceptability

Materials and methods

Materials: Freshly harvested *T. occidentalis* fruits were obtained from a local farm in Ahoada East Local Government Area of Rivers State. *D. alata* tubers were purchased from Mile One Market in Port Harcourt. Sugar, shortening (Simas margarine), eggs, salt, nutnemg, baking powder, milk, vanilla essence, etc were bought from mile three market in Port Harcourt. All equipment, reagents and chemical used were of analytical grade.

Production of *Dioscorea alata* flour: *D.alata* tubers were washed in running tap water and peeled manually using a stainless steel knife. The tubers were then sliced and re-washed. The sliced *D. alata* were soaked in tap water containing sodium meta-bisulphite in order to prevent any browning reaction and were blanched in hot water at temperature of 100^0c for a minute. The blanched *D. alata* were oven dried at 60^0c for 18 hours in a hot-air fan oven (model QUB 305010G Gallenkamp UK), milled using a commercial mill and screened through a 500mm mesh size British standard sieve (model BS 410

Endecott Ltd London, UK) to obtain a uniform fine flour and stored in an air-tight plastic container at room temperature (37^0c) until used.

Production of *Telfairia occidentalis* seed flour: *T. occidentalis* fruits were cut open to obtain the seeds. The seeds were separated from the pulp; seeds with intact coats were washed in running tap water. The seeds were then boiled in tap water containing sodium-meta-bisulphite in a covered stainless steel pot for I hour to soften the seeds coats. The seeds were allowed to cool and then dehulled manually. It was rewashed, sliced and oven dried at 60^0c for 24hrs in a hot-air fan oven (model QUB 305010G Gallen Kamp, U.K). The dried seeds were ground using a commercial mill and sieved through a 500mm British standard sieve (model Bs 410, Endecott Ltd. London, U.K). The flour obtained was defatted using n-hexane as solvent. The defatted flour was oven dried at 50^0c for 30 minutes to remove residues of n-hexane. The flour was re-milled then stored in an air-tight plastic container at room temperature (37^0c) until used.

Sample formulation: Four samples were formulated for each of the products. 100 percent wheat flour was used as control for both products while the other samples were produced from *D. alata* and *T. occidentalis* seeds flour using a ratio of 90:10, 80:20 and 70:30.

Production of cuts of Chin Chin (One cm square or about one quarter of an inch)

Recipe

Ingredients	Quantity
Flour	200g
Sugar	80g
Margarine	80g
Baking powder	½ tsp
Nutmeg	1 tsp
Eggs	2
Milk	20ml
Water	20ml
Salt	0.3g

Procedure for preparation of cuts of chin chin

1. Sieve all dried ingredients
2. Rub in fat and flour
3. Add sugar
4. Add milk and water
5. Knead by hand on a flat clean table
6. Roll thinly to a uniform thickness
7. Cut into cubes using a cutter
8. Deep fry in hot vegetable oil in an aluminum utensil until brown
9. Drain within 10 minutes
10. Allow to cool.

Production of Strips of chin chin (one cm by ten cm)

Recipe

Ingredient	Quantity
Flour	200g
Sugar	80g
Margarine	80g
Baking powder	½ tsp
Nutmeg	½ tsp
Eggs	2
Milk	20ml
Salt	0.3g

Procedure for preparation of strips of chin chin

1. Sieve all dried ingredients
2. Rub in margarine
3. Add Sugar
4. Add milk and water
5. Knead by hand on a flat clean table
6. Use hand to roll out strip shape
7. Deep fry in hot vegetable oil in an aluminum utensil until brown
8. Drain within 5 minutes
9. Allow to cool and then pack.

Chemical analysis: The proximate composition of the sample was determined according to standard AOAC methods (AOAC, 1995). Crude protein was determined by Kjeldahi method. A factor of 6.25 was used to convert N_2 to protein. Fat was determined by soxhlet extraction method using petroleum spirit as solvent while, carbohydrate was determined by difference. Ash was determined by atomic absorption spectrophotometry (UV = Visible 754, China). Crude fibre was determined according to AOAC 1995.

Sensory evaluation: Coded samples of cuts of chin chin and strips of chin chin were placed on white saucers and presented to a twenty member panel consisting of staff and student of Federal College of Education (Technical) Omoku. The panelists were selected on the basis of age not less than 18 years and familiarity with the products. An evaluation sheet designed on a nine point hedonic scale was used for the evaluation of the samples with one (1) representing dislike extremely and nine (9) like extremely (Iwe, 2002). The attributes assessed were colour, texture, taste, flavour and general acceptability. The panelists were instructed to rate colour before tasting each product. Water was supplied to the panelists for rinsing their mouth in between tasting. Analysis of variance (ANOVA) was performed on the data collected to determine differences while Duncan Multiple Range Test (DMRT) was used to detect significant difference among the means at a level of 0.05.

Results

Table 1: Proximate Composition of Cuts of Chin Chin

	Moisture Content (%)	Ash (%)	Fat (%)	Protein (%)	Carbohydrate (%)	Crude Fibre
CHA	2.38^c	0.93^b	43.01^a	5.27^a	46.70^a	0.34^b
CHB	3.77^c	1.36^a	38.94^b	5.98^b	46.65^a	1.30^a
CHC	7.43^a	1.46^a	42.99^a	6.31^a	40.81^c	1.00^a
CHD	4.45^b	1.07^b	46.10^a	6.55^a	38.79^b	1.04^a

Means with the same superscript on a column are not significantly difference at ($P \leq 0.05$)
CHA - 100% wheat flour (control), CHB – 90% *D.alata* and 10% *T. occidentalis,*
CHC – 80% *D.alata* and 20% *T. occidentalis*, CHD - 70% *D.alata* and 30% *T. occidentalis*

The proximate composition of cuts of chin chin is presented in Table 1. Values for moisture content ranged from 2.38% in sample CHA to 7.43% in CHC. Ash content ranged from 0.93% in CHA to 1.46% in CHC with values for fat ranging from 42.99% in CHC to 46.10% in CHD. Protein ranged from 5.27% to 6.55%. Carbohydrate ranged from 38.79% in CHD to 46.70% in CHA with values for crude fibre ranging from 0.34% in sample CHA to 1.30% in CHB.

Table 2: Proximate Composition of Strips of chin chin

	Moisture Content (%)	Ash (%)	Fat (%)	Protein (%)	Carbohydrate (%)	Crude Fibre
STA	4.85[a]	0.57[c]	48.74[a]	4.70[c]	49.99[b]	1.42[b]
STB	3.33[b]	2.37[a]	36.53[b]	5.10[b]	50.38[b]	1.29[b]
STC	4.79[a]	1.32[b]	36.31[b]	5.90[a]	50.20[b]	1.66[a]
STD	3.74[c]	1.46[b]	36.28[b]	6.50[a]	51.60[a]	0.96[c]

Means with the same superscript on a column are not significantly difference at ($P \leq 0.05$)
STA - 100% wheat flour (control), STB – 90% *D. alata* and 10% *T. occidentalis*,
STC – 80% *D. alata* and 20% *T. occidentalis*, STD - 70% *D.alata* and 30% *T. occidentalis*

Table 2 shows result for proximate composition of strips of chin chin. Values for moisture content ranged from 3.33% in STB to 4.85% in STA. The ash content ranged from 0.57% in STA to 2.37% in STB Values for fat ranged from 36.28% in STD to 48.74% in STA. Protein ranged from 4.70% in STA to 6.50% in STD. STD was highest for carbohydrate. Result for crude fibre ranged from 0.96% in STD to 1.66% in STC.

Table 3: Sensory Evaluation of cuts of Chin Chin

	CHA	CHB	CHC	CHD	LSD (P<0.05)
Colour	6.60[a]	5.60[a]	5.15[a]	3.25[b]	1.40
Texture	6.65[a]	4.25[a]	4.80[a]	3.4[b]	1.38
Taste	6.00[a]	4.35[b]	4.25[b]	3.75[c]	0.98
Flavour	5.35[a]	4.85[a]	5.10[a]	3.45[b]	0.85
General Acceptability	6.15[a]	4.65[a]	4.55[a]	3.25[b]	1.18

Means with the same superscript on a row are not significantly different at ($P \leq 0.05$)
CHA - 100% wheat flour (control), CHB – 90% *D.alata* and 10% *T. occidentalis,*
CHC – 80% D.alata and 20% T. occidentalis, CHD - 70% D.alata and 30% T. occidentalis

Table 3 shows the mean scores for cuts of chin chin prepared from 100 percent wheat flour and composite flour of *D. alata* and *T. occidentalis* seeds flour. Sample CHA was rated highest followed by sample CHB while CHD was rated least for all the attributes evaluated.

Table 4: Sensory Evaluation of Strips of chin chin

	STA	STB	STC	STD	LSD (P<0.05)
Colour	7.65[a]	5.20[b]	4.75[c]	2.30[b]	2.19
Texture	6.75[a]	5.40[b]	3.40[b]	2.05[c]	2.09
Taste	7.65[a]	5.65[a]	3.35[b]	2.15[b]	2.45
Flavour	7.00[a]	5.20[a]	3.05[a]	1.65[b]	2.35
General Acceptability	7.15[a]	5.65[a]	3.70[b]	1.85[b]	2.31

Means with the same superscript on a row are not significantly different at ($P \leq 0.05$)
STA - 100% wheat flour (control), STB – 90% *D. alata* and 10% *T. occidentalis*,
STC – 80% *D. alata* and 20% *T. occidentalis*, STD - 70% *D.alata* and 30% *T. occidentalis*

Table 4 summarizes the mean sensory scores for strips of chin chin. The panelists rated the control (sample STA) highest followed by sample STB with STD being the least preferred for all the attributes evaluated.

Discussion

Results from the proximate composition of the chin chin (cuts and strips) shows that the protein content of the samples produced from the composite flour of *D.alata* and *T.occidentalis* seeds had higher protein content than the control (100% wheat flour). This could be due to the significant quantity of protein in *T.occidentalis* seeds flour as reported in various researches (Giami, Achinewhu and Ibaakee, 2005; Hamed, El Hassan, Hassan, Eltayeb and Babiker, 2008). A similar observation was reported by Abayomi, *et al* (2013) that cookies produced from blends of sweet potato flour and soy bean flour had higher protein content. Chinma *et al* (2007) reported that composite flour produced from legumes and tubers have high protein content and calorific value. An increase in ash content was also observed in products made from the composite flour. It then follows that the chin chin produced from the composite flours has a higher mineral content than those from wheat flour. This result agrees with the findings of Agu and Aluyah (2004) which reported a high mineral content in maize-soyabean-fluted pumpkin seeds blends with ash content of 2%. Idowu (2014) also reported high ash content in biscuits produced from composite flours of wheat and African yam bean. The carbohydrate content of the products from composite flour decreased with increase in addition of *T.occidentalis* seeds flour. *T.occidentalis* seed is known to contain low carbohydrate than wheat flour (Ibaakee, 2008).

Statistical results of the sensory attributes of colour (appearance) shows that, the control samples (CHA and STA) were rated highest, followed by sample CHB and STB with (10%) supplementation. Appearance of a food is usually the first sign of edibility (Iwe and Egwuekwu, 2010). The texture of the control samples (100% wheat flour) had higher values than other samples. Chinma, Igbabul and Omotayo (2012) also reported a higher texture score for 100% wheat flour cookies which they attributed to the presence of gluten in wheat flour. The texture of food depends a lot on the starch content (Iwe and Egwuekwu, 2010). Result of proximate composition also showed that the control had higher carbohydrate content than the other samples. The mean value for taste showed that samples CHD and STD with 30% *T. occidentalis* seeds flour were rated lowest. The quality attributes decreased with increase in the level of *T. occidentalis* seeds flour addition with respect to taste and flavour. Ibaakee (2008) also observed that cookies and chin chin containing more than 10% pumpkin seed flour have an after taste. For general acceptability, the control samples CHA and STA were most preferred, followed by samples CHB and STB with 10% level of addition of *T.occidentalis* seeds flour.

Conclusion

This study has shown that the addition of *T.occidentalis* seeds flour to *D.alata* flour increased the protein and also the ash content of the snacks and this indicates a higher nutritional value with respect to the protein and mineral content. The sensory attributes of chin chin (cuts and strips) with (10%) addition was most preferred.

This shows that (10%) *T. occidentalis* seeds flour can be added to flours for snacks production to improve its nutritional value and eating quality. This will no doubt contribute to reducing the problem of protein-energy malnutrition (PEM). The utilization of composite flour from *D.alata* tubers and *T.occidentalis* seeds for snacks production will add value to these crops and reduce the dependence on wheat flour for snacks production.

Recommendations

Based on the findings of this study, it is therefore recommended that:-

- Substituting up to 10% of *T.occidentalis* seed flour in product development using *D.alata* will enhance its nutritional composition.
- Products developed from a blend of *D.alata* and *T.occidentalis* seeds flour can be very useful snack product.
- *D.alata* and *T.occidentalis* seeds flour blend can find useful application for snacks products for which wheat flour has been used.
- Popularizing the use of these flour blends for such products for which wheat flour is used will go a long way to reduce the country's dependency on wheat flour, thereby saving scarce foreign exchange.

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