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Chemical Analysis and Organoleptic Evaluation of Snacks from Composite Flour of *Dioscorea alata* and *Telifairia occidentalis* Seeds Flour

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Abstract **- The study was aimed at developing snacks (rockbuns biscuits and queen's cake) from composite flour of *Dioscorea alata* (water yam) and defatted *Telfairia occidentalis* seeds (fluted pumpkin seeds) and to evaluate the snacks for acceptability. The study adopted an experimental design. *D.alata* tubers and T. *occidentalis* seeds were processed into flour using different methods. Rockbuns, biscuits and queen's cake were produced from the composite flour. Chemical composition of these snacks were determined. The samples were also subjected to organaleptic analysis on (colour, texture, taste, flavour and General Acceptability). A nine – point hedonic scale was used. Twenty panelists were used for the evaluation. Data was analyzed using mean and analysis of variance (ANOVA). Supplementing defatted *T.occidentalis* seeds flour at 10%, 20% and 30% resulted in an increased in protein and Ash content of the snacks. For Rockbuns, protein content ranged from (5.09%) to (7.78%), for Biscuits, the protein content raged from (5.41%) to (6.82%), and for Queen's cake, (5.58%) to (6.82%). Result of organnoleptic evaluation revealed that, 100% wheat flour (control) was most preferred, followed by samples with 90%. *D.alata* and 10% *T.occidentalis* seeds flour for all the samples. It was concluded that *D.alata* and *T. occidentalis* seeds flour blends at 90:10 ratio could find useful application for snacks products for which wheat flour has been used.**

Keywords **– Analysis, Acceptability, Composite flour, Evaluation, Organoleptic.**

I. Introduction

Protein malnutrition is a major public health problem in most developing world; diet in these parts are predominantly starchy, the major food crops being roots and tubers. In countries such as Nigeria, animal products representing high concentration and quality of protein are either unaffordable or too expensive thus, increasing the dependence on, tuber, roots and cereal crops. This has resulted in an inadequate intake of protein leading to various forms of malnutrition in both children and adult. It has been reported that in developing countries including Nigeria, malnutrition persists as a principal health problem among children below the age of five (UNICEF, 1996). Tuber and root crops are consumed in Nigeria in several forms. In most cases, they are milled into flour and used in preparing various items, (Fasasi, Adeyemi and Fagbenro, 2010). Roots and Tubers are often considered as an inferior food because they are low in protein, essential minerals and vitamins, therefore the need to find alternative sources of protein of good quality.

Dioscorea alata is a tuber crop widely cultivated in Nigeria, it is used in the production of various food items such as pounded yams, a replacement for maize in diets for laying hens, amala (popular darkish Nigeria food), snacks among others Adams, 2010). Snacks according to Anozie, China and Beleya, (2014) are small meals eaten between the main meals in order to maintain health, while satisfying appetite. In the same vein, Okpala and Okpala cited in Anozie et al, (2014), noted that, snacks are often smaller than the regular meals and are designed to be portable, quick and satisfying than prepared meals. Many snacks are low in nutritional value. However, in recent times, snack are being supplemented as to provide consumers with 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, Beleya, Eke and Owuno, 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-

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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 ungiiiculntta),* African Yambean *(Sphenostylis stenocarpa),* fluted pumpkin seed *(Telfairia occidentalis)* etc (Sanni *et al*, 2006). According to the authors, *Tdfairia 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 (Giarni 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 (Rockbuns, Biscuits and Queen's cake) produced from composite flour of *Dioscorea alata* and *Telfairia occidentalis* seeds flour.

II. Purpose of the Study

The purpose of this research was *to* develop snacks (Ruckbuns, Biscuits and Queen's cake) 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 chemical 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

III. 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, nutmeg, 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°c for a minute. The blanched D. *alata* were oven dried at 60°c 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 airtight plastic container at room temperature (37°c) 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°c for 24hrs in a hot-air fan oven (model QUB 30501OG 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°c 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°c) until used.

Sample Formulation

Four samples were formulated for each of the products. 100 percent wheat flour was used as control for all the samples while, the other samples were produced from D.alata and T. occidentalis seeds flour using a ratio of 90:10, 0:20 and 70:30.

Production of rockbuns recipe

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

Procedure for preparation of rockbuns

1. Sieve all dried ingredients
2. Rub in fat and flour
3. Add sugar
4. Beat egg with milk until mixture becomes foamy
5. Add mixture and water to form consistency that can hold its shape
6. Pile in a greased baking tray in rough heaps
7. Bake in a hot oven for 15 minutes
8. Allow to cool
9. Serve

Production of Biscuits Recipe

Ingredients	Quantity
Flour	200g
Margarine	80g
Sugar	80g
Baking powder	½ tsp
Milk	20ml
Water	20ml

Procedure for production of biscuits

1. Sieve all dried ingredients
2. Rub in fat and flour
3. Sir in the sugar
4. Add milk and sufficient water to form a stiff dough
5. Roll out thinly and prick with a fork
6. Cut with a biscuit cutter and place in a well greased baking tray
7. Bake in a moderately hot oven for 5-10 minutes
8. Allow to cool
9. Serve

Production of Queen's Cake Recipe

Ingredients	Quantity
Flour	200g
Sugar	80g
Margarine	80g
Baking power	½ tsp
Nutmeg	1tsp
Milk	20ml
Vanilla essence	½ tsp

Procedure for the production of Queens cake

1. Sieve all dried ingredients
2. Cream fat and sugar in a bowl until soft and fluffy
3. Add beaten eggs in bits mixing vigorously in each addition to prevent cuddling
4. Add sieved flour, baking powder, nutmeg
5. Add milk and vanilla essence to get a high dropping consistency
6. Pile in a well greased petty cake pans
7. Bake in moderately hot oven for 15-20 minutes
8. Allow to cool and remove from the pans
9. Serve.

Chemical Analysis

The proximate composition of the sample was determined according to standard AOAC methods (AO A C, 1995). Crude protein was determined by Kjeldahi method. A factor of 6.25 was used to convert N2 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 rockbunns biscuits and queen's cake were placed on white saucers and presented to a twenty members panel consisting of staff and students 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.

IV. Result

Table 1: Proximate Composition of Ruckbuns

	Moisture Content (%)	Ash (%)	Fat (%)	Protein (%)	Carbo hydrate (%)	Crude Fibre
RBA	9.48^b	1.101^b	22.1^a	5.09^b	61.52^a	0.49^b
RBB	13.38^a	2.31^a	20.93^b	51.16^b	57.51^b	0.72^a
RBC	13.23^a	2.32^a	21.56^a	7.07^a	54.88^b	0.94^a
RBD	13.83^a	2.06^a	22.91^a	7.78^a	53.93^b	0.25^c

Means with the same superscript on a column are not significantly difference at ($P \leq 0.05$) RBA – 100% wheat flour (control), RBB – 90% D.alata and 10% T.occidenatalis. RBC – 80% D.alata and 20%, RBD – 70% D.alata and 30% T. occidentalis.

The proximate composition of rockbuns is presented in Table 1. value for moisture content ranged from 9.48% in sample RBA to 13.83 in RBD. Ash content ranged from 1.01% in sample RBA to 2.32% in RBC with values for fat ranging from 20.93% in RBB to 22.91% in RBD. Protein ranged from 5.09% in sample RBA to7.78% in RBD. Carbohydrate ranged from 53.93% in RBD to 61.52% in RBA with value for crude fibre ranging from 0.25 in sample RBA to 0.94 in RBC.

Table 2: Proximate Composition of Biscuits

	Moisture Content (%)	Ash (%)	Fat (%)	Crude Protein (%)	Carbohydrate (%)	Crude Fibre
BAH	5.40^b	0.28^b	20.10^b	5.41^b	66.51^a	1.30^a
BSB	5.21^b	1.79^a	19.80^b	5.94^b	66.24^a	1.02^b
BSC	6.06^a	11.31^a	20.73^b	6.38^a	63.62^b	1.61^a

BSD	7.64[a]	1.89[a]	21.39[a]	6.82[a]	61.26[b]	0.75[b]

Means with the same superscript on a column are not significantly difference at P ≤ 0.05 BSA – 100% wheat flour (control), BSB – 90% D.alata and 10% T. occidentalis, BSC – 80% D.alata and 20% T. occidentalis, BSD – 70% D.alata and 30% T.occidentalis.

Table 2 shows result for proximate composition of Biscuits. Value for moisture content ranged from 5.21% I sample BSB to 7.64 in BSD, with value for Ash ranging from 0.28 in sample BSA to 1.89% in BSD. Values for fat ranged from 19.80% in sample BSB to 21.39 in BSD. Protein content ranged from 5.41% in sample BSA to 6.82% in BSD with sample for carbohydrate ranging from 6.28% in sample BSA to 66.24% in BSB. Result for crude fibre ranged from 0.75% in sample BSD to 1.02% in BSB.

Table 3: Proximate Composition for Queen's Cake

	Moisture Content (%)	Ash (%)	Fat (%)	Crude Protein (%)	Carbohydrate (%)	Crude Fibre
QCA	20.02[a]	1.32[b]	19.19[b]	5.58[b]	53.46[a]	0.43[b]
QCB	15.99[b]	2.69[a]	20.00[b]	5.78[b]	54.86[a]	0.84[a]
QCC	17.48[a]	2.29[a]	18.09[b]	5.78[b]	56.14[a]	0.22[b]
QCD	18.88[a]	2.36[a]	23.5[a]	6.82[a]	48.05[b]	0.35[b]

Means with the same superscript on a column are not significantly difference at (P≤ 0.05) QCA – 100% wheat flour (control), QCB – 90% D.alata and 10% T.occidenatalis. QCC – 80% D.alata and 20%, QCD – 70% D.alata and 30% T. occidentalis.

The proximate composition of queen's cake is presented in Table 3. value for moisture content ranged from 15.99% in sample QCB to 20.02% in QCA. Ash content ranged from 1.32% in sample QCA to 2.69% in QCB with value for fat ranging from 18.09% in QCC to 19.19% in sample QCA. Protein ranged from 5.58% in sample QCA to 6.82% in QCD. Value for carbohydrate ranged from 48.05% in sample QCD to 56.14% in QCC, with value for crude fibre ranging from 0.35% in QCD to 0.84% in QCB.

Table 4: Sensory Evaluation of Ruckbuns

	RBA	RBB	RBC	RBD	LSD (P≤0.05)
Colour	8.20[a]	6.55[a]	4.00[b]	2.65[a]	2.49
Texure	8.15[a]	5.50[a]	3.00[a]	1.55[b]	2.19
Taste	8.16[a]	4.30[b]	1.70[b]	1.20[b]	3.38
Flavour	8.30[a]	3.95[b]	1.20[b]	1.10[b]	3.38
General Acceptability	8.40[a]	4.15[b]	1.50[b]	1.25[b]	3.32

Means with the same superscript on a column are not significantly difference at (P≤ 0.05) RBA – 100% wheat flour (control), RBB – 90% D.alata and 10% T.occidenatalis. RBC – 80% D.alata and 20%, RBD – 70% D.alata and 30% T. occidentalis.

Table 4 shows the mean score for Rockbuns prepared from 100 percent wheat flour and composite flour of D.alata and T.occidentalis seeds flour. Sample RBA was rated highest followed by sample RBA while RBD was rated least for all the attribute evaluated.

Table 5: Sensory Evaluation of Biscuit

	RBA	RBB	RBC	RBD	LSD (P≤0.05)
Colour	8.60[a]	6.60[a]	4.55[b]	2.35[b]	2.65
Texure	7.40[a]	5.20[a]	3.60[b]	2.00[b]	2.31
Taste	7.75[a]	4.95[a]	3.30[b]	1.80[b]	2.51
Flavour	7.65	4.45[b]	2.85[b]	1.20[b]	2.75
General Acceptability	7.90[a]	5.25[a]	3.15[b]	1.60[b]	2.72

Means with the same superscript on a column are not significantly difference at (P≤ 0.05) RBA – 100% wheat flour (control), RBB – 90% D.alata and 10% T.occidenatalis. RBC – 80% D.alata and 20%, RBD – 70% D.alata and 30% T. occidentalis.

Table 5 summarizes the mean sensory score for biscuits. The panelists rated the control, (sample BSA) highest, followed by sample BSB with sample BSD being the least preferred for all the attribute evaluated.

Table 6: Sensory Evaluation of Queen's Cake

	QCA	QCB	QCC	QCD	LSD (P≤0.05)
Colour	6.65[a]	6.45[b]	4.80[a]	2.60[b]	1.87
Texure	7.20[a]	5.00[b]	4.00[b]	2.30[b]	2.04
Taste	7.35[a]	5.15[a]	3.50[b]	1.45[c]	5.51

Flavour	7.00[a]	5.15[a]	3.00[b]	1.55[b]	2.39
General Acceptability	7.60[a]	5.80[a]	3.85[a]	1.60[b]	2.57

Means with the same superscript on a column are not significantly difference at (P≤ 0.05) QCA – 100% wheat flour (control), QCB – 90% D.alata and 10% T.occidenatalis. QCC – 80% D.alata and 20%, QCD – 70% D.alata and 30% T. occidentalis.

Table 6 shows the mean sensory score for Queen's cake prepared from 100 percent wheat flour 9control) and composite flour of *D.alata* and *T.occidentalis* seed flour. For all the attributes evaluated sample QCA had the highest rating followed by same QCB, while QCD was rated least.

V. Discussion

Results from the chemical composition of rockbuns, biscuits and queen's cake shows that the protein content of the samples produced from the composite flour of *D.alata* and *T.occidentalis* had higher protein content than the control (100% wheat flour). This could be due to the significant quantity of protein in *Telfaria occidentalis* seeds flour as noted by (Anozie; et al, 2014; Giami, Achinewhu and Ibaakee, 2005; hamed, El-Hassan, Eltayeb and Babiker, 2008). The same observation was reported by Abayomi, Oresanya, Opeifa and Rasheed (2013), that cookies produced from blends of sheet potato flour and soybean flour had higher protein content. Anozie et al (2014), reported that composite flour produced from legumes and tubers have high protein content and calorific value. There was an increase in ash content of all the samples produced from the composite flour of *D.alata* and *T.occidentalis* seed flour.

This result is in accordance with the report of Agu and Aluyah cited in Anozie et al, (2014) high mineral content in maize soybean fluted pumpkin seeds blends with ash content of 2%. Increased ash composite flour of wheat and African yam been was also reported by Idowu, 2014. Decrease in the carbohydrate content of the samples produced from the composite flour of *D.alata* and *T.occidentalis* seed flour agrees with the report of Ibaakee (2008) that, carbohydrate content of products from composite flour decreased with an increase in addition of *T.occidentalis* seed flour, *T.occidentalis* seed according to Ibaakee is known to contain low carbohydrate than wheat flour. However there was an increase in carbohydrate content of the control samples. Results of the sensory evaluation of colour shows that, the control RBA, RSA and QCA were rated highest followed by sample RBB, BSB and QCB with 10% supplementation.

Appearance of food is usually the first sign of acceptability and edibility of a food product (Anozie et al, 2014). The texture of all the samples produced from 100% wheat flour (control) had higher scores than the samples produced from the composite flour of *D.alata* and *T.occidentalis* seed flour. Chinma, Igbabul and Omotayo (2012) reported a higher texture score for 100% wheat flour cookies which was attributed to the presence of gluten in wheat flour. Texture of food according to Iwe and Egwuekwu, (2010) depends a lot on the starch content. The mean sensory score for taste showed that sample RBD, BSD and QCD 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. Anozie et al (2014) observed that cut of chinchin and strips of chinchin containing more than 10% *T.occidentalis* seeds flour have an after taste and this affected their rating. For general acceptaibility, sample RBA, BSA and QCA were most preferred, followed by samples RBB, BSB and QCB with 10% level of supplement of *T.occidentalis* seeds flour.

VI. Conclusion

The chemical analysis of snacks made from composite flour of *D.alata* and *T.occcidentalis* seeds flours showed significant increase in protein and Ash content, and this indicates a high nutritional value with respect to protein and mineral content. The statistical analysis of the sensory evaluation of Ruckbuns, Biscuits and Queen's cake with 10% supplementation of *T.occidentalis* seeds flour were most preferred after the control samples. This revealed that 10% *T.occidentalis* seeds flour can be added to flours for snacks production to improve its nutritional value and eating quality. This without skepticism will contribute to reducing the problem of protein-energy malnutrition. Use of composite flour for snacks making will add value to these local crops and reduce over dependence on wheat flour thereby saving the country's foreign exchange earrings.

VII. Recommendation

Based on the result of this research, it is therefore recommended that;

1. *D.alata* and *T.occidentalis* seeds flour blends can find useful application for snacks products for which wheat flour has been used.
2. Products developed from a blend of *D.alata* and *T.occidentalis* seeds flour can be very useful snacks product in respect to nutritional value.
3. Popularizing the use of these flour blends for such products for which wheat flour is used, will go along way to reduce the country's dependency on wheat flour hereby saving scarce foreign exchange.
4. Substituting up to 10% level of *T.occidenntalis* seeds flour in product development using *D.alata* and other root and tuber crops, including cereals will improve its nutritional value.

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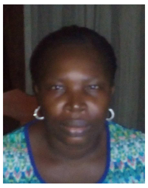

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