Nutrient and Mineral Contents of Traditional Porridge 'Ikokore' Prepared with Different Yam Species

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ABSTRACT

***Background**: "Ikokore" is originated from Ijebu tribe located in Ogun State but the meal has gained popularity and prepared among many other tribes of Nigeria this day. However, little is known about the nutritional status of this meal. Therefore this study aimed at investigating and comparing the nutrient contents of this meal.*

***Methods:** Equal amount of water, smoked fish, grounded pepper, fermented melon seed and salt were added into each pot corresponding to a yam specie, mixed and boiled for 10 minutes. Then 500 g each of peeled and grated yam species were added to each pot and again boil for 10 minutes. Finally, equal amount of palm oil was also added and allowed to simmer for another 10 minutes and thereafter stirred well to obtain "Ikokore" meal. Their proximate analysis, macronutrients and mineral contents were then determined.*

***Results:** "Ikokore" from D. alata had significantly higher ($P < 0.05$) moisture (74.58%), ash 10.74%) and protein (8.70%) contents compared with those of D. rotundata and C. esculenta. "Ikokore" from D. rotundata had highest fibre (4.00%) compared with others. D. alata contains the highest number of minerals compared with the other two species. However, potassium (4.983 ± 149.00 g/ppm) and iron (2216.834 ± 100 g/ppm) contents of "ikokore" prepared with D. rotundata were significantly higher than those of D. alata and C. esculenta. Manganese was not detected in the meals.*

***Conclusion:** The three "Ikokore" meals are fairly good sources of energy, minerals and other nutrient macromolecules with D. alata revealing better results.*

Keywords: Yam species, Nutrients, "Ikokore", energy.

INTRODUCTION

Yams are starchy underground tubers from the genus *Dioscorea,* with three main species: white yam (*Dioscorea rotundata*), cocoyam (*Colocasia esculenta*) and water yam (*Dioscorea alata*) [1]. They exhibit adaptation to diverse soil, environmental conditions and wide variety of farming system when compared to other food crops. Their production pattern reflect the agro-climate, traditional farming practices and often the local cultural heritage of the area production.

Yams have soft texture and are easily bruised, perishable within few days to months. Their spoilage is usually caused by rotting (brought about by bacteria and fungi), senescence, sprouting and bruising [3].

Yams are eaten roasted, boiled or baked. Tubers of *D. alata* are grated and fried into cakes. Flour prepared from the tubers is used for preparation of dough (amala) in some part of Nigeria [1, 4].

Traditional yam porridge ("ikokore") is a staple dish of the "Ijebu" tribe in Ogun State, South-western part of Nigeria. However, other tribes of Nigeria are now use to preparing and enjoying this meal. All these yam species are used for the preparation of "ikokore" but the most preferred is water yam (*D. alata)*. This meal is not costly to prepare and could be served any time of the day,

but most preferred as breakfast or supper. "Ikokore" meal can be served alone but the typical "Ijebu" preferred to serve it along with cooked solid pap (locally known as "eko"- Yoruba) usually rapped in leaves, cold eba, or with fufu depending on individual's choice. Although introduced by the Ijebus, some many other tribes are now used to the cooking of Ikokore.

Materials and Methods

Materials

Yam samples: White yam (*Dioscorea rotundata*), cocoyam (*Colocasia esculenta)* and water yam (*Dioscorea alata*) were purchased from the Ipata market, Ilorin, Kwara State, Nigeria.

Other ingredients: Smoked fish, red palm oil, salt, ground pepper and fermented melon seed ("iru-ogiri") were also purchased from the same market.

Chemicals and Reagents: The chemicals and reagents used were products of Randox Laboratories limited, United Kingdom and were of analytical grades.

Methods

Preparation of "Ikokore" Meals from Yam Species: Equal amount of water (1 litre) was put in three pots (one pot for each yam specie). The same quantities of pieces of smoked flaked fish (100 g), grounded pepper (10 g), fermented melon seed "Iru-ogiri" (20 g), and salt (5 g) were added into each pot and the mixture boiled for 10 minutes. Then five hundred grammes (500 g) each of already peeled yam tuber samples (*D. rotundata*, *C. esculenta* and *D. alata*) was separately washed, grated and small balls cut scooped with hands or spoon added to the boiling mixture in the corresponding pot and allowed to boil for 10 minutes without stirring. The same quantity of palm oil (75 g) was thereafter added last into each pot and allowed to simmer (lowering the heat) for another 10 minutes (see summary in Table I below). The contents of each pot were then stirred very well to obtain the "ikokore" meal.

Proximate Analysis of the Prepared "Ikokore" Meals: One hundred grammes (100 g) of each "ikokore" meal was dried in an oven at 40^0 C until constant weight was obtained. Each of the dried meal was then grounded separately in a mortar into powdered form and stored in the fridge at 4°C until required for analysis. Their proximate analyses were carried out using the methods of A.O.A.C., 2005 with 0.3 g each of the powdered "ikokore" meal for the determination of moisture, ash, crude fibre, protein and carbohydrate contents to obtain their percentage dry weights [5].

Their corresponding percentage wet weights of nutrients from the determined percentage dry weights were also obtained/calculated using the formula:

Determination of Percentage (%) wet weight:

$$\frac{\mathbf{D}}{100} \times \frac{100 - \mathbf{M}}{1}$$

Where:

D = Obtained % dry weight of each nutrient

M = Moisture content of the whole sample

Table I: Ingredients for Preparation of "Ikokore" Meals from Yam Species

Ingredients	Ikokore 1 (g)	Ikokore 2 (g)	Ikokore 3 (g)
Yam	D. alata (500)	D. rotundata (500)	D. esculenta (500)
Smoked fish	100	100	100
Ground pepper	10	10	10
Iru-ogiri	20	20	20
Red palm oil	75	75	75
Salt	5	5	5
Water	1000 ml	1000 ml	1000 ml

In addition, meals are usually consumed in wet form. Therefore, macronutrients (in grammes) from each Ikokore" meal from these yam species were obtained as below:

Determination of Macronutrient Contents Based on Wet Weight:

$$\left[\frac{\frac{W}{100} \times \frac{A}{1} \times \frac{T}{1}}{A}\right]$$

Where:

W = Obtained % wet weight of each nutrient.
A = Amount of analysed sample.
T = Total weight of the whole sample.

Furthermore, the amount of calorie obtainable from carbohydrate contents of these meals were also derived from the below simple formula:

Determination of Derivable Calorie from Carbohydrate Content of the Sample:

$$\frac{W \times 4 \times T}{100}$$

Where:

4 = Kcal (equivalent to 1 g of carbohydrate content of the sample).

Determination of Mineral Contents: The mineral contents of the three "ikokore" meals were determined with X-Ray Fluorescence Spectrometers.

RESULTS

The comparison of nutritional compositions of the meals is based on their inherent percentage dry weights.

The "ikokore" prepared with *D. alata* contained significantly higher moisture (74.58 ±0.06), ash (10.74 ±0.02) and protein (8.70 ± 0.04) contents compared with the other yam samples. There was no significant difference between the moisture (72.84 ± 0.04 and 72.60 ± 0.03 respectively) contents of "ikokore" prepared with *D. rotundata* and *C. esculenta*. Whereas "ikokore" prepared with *D. rotundata* had higher percentages of fibre and carbohydrate, no significant difference between the fibre contents of *D. alata* compared with *C. esculenta* was observed, but "ikokore" prepared with *C. esculenta* contained higher fat when compared with the remaining two yam species with the one prepared with *D. alata* having the least (Tables II).

Table II: Proximate Analysis of "Ikokore" Meals Prepared with Yam species (% Dried and Wet weight)

Nutrients	*D. rotundata*		*C. esculenta*		*D. alata*	
	Dry weight	**Wet weight**	**Dry weight**	**Wet weight**	**Dry weight**	**Wet weight**
Moisture	72.84 ± 0.04^a	72.84 ± 0.04^a	72.60 ± 0.03^a	72.60 ± 0.03^a	74.58 ±0.06^b	74.58 ±0.06^b
Ash	6.64 ± 0.05^a	1.80 ± 0.05^a	8.88 ± 0.07^b	2.43 ± 0.07^b	10.74 ±0.02^c	2.73 ± 0.02^c
Protein	6.05 ± 0.43^a	1.64 ± 0.43^a	7.00 ± 0.12^b	1.92 ± 0.12^b	8.70 ± 0.04^c	2.21 ± 0.04^c
Fibre	4.00 ± 0.06^a	1.09 ± 0.06^a	3.00 ± 0.02^b	0.82 ± 0.02^b	3.00 ± 0.04^b	0.76 ± 0.04^b
Fat	6.07 ± 0.01^a	1.65 ± 0.01^a	8.20 ± 0.04^b	2.25 ± 0.04^b	4.48 ± 0.06^c	1.14 ± 0.06^c
Carbohydrate	77.24± 0.08^a	20.98 ± 0.08^a	72.92 ±0.05^b	19.98 ±0.05^b	73.08 ±0.08^c	18.58 ±0.08^c

Results are expressed as means ± SD, n = 5, P < 0.05

In terms of macronutrient contents, the amount (in grammes) of ash (13.65 ± 0.00 g) and protein (11.05 ± 0.02) found in the meals prepared with *D. alata* were significantly (P < 0.05) higher than those of *D. rotundata* and *C. esculenta*. In addition, the fibre (5.45 ± 0.04) content of "ikokore" meals from *D. rotundata* is significantly (P < 0.05) higher compared with the other two yam species while *C. esculenta* has the highest fat (11.25 ± 0.01). Furthermore, carbohydrate (104.90 ± 0.00) of "Ikokore" meals prepared with *D. rotundata* is significantly (P < 0.05) higher compared with the other two yam species while the one prepared with *D. alata* has the least (92.90 ± 0.00). Therefore, derivative energy from "Ikokore" meals prepared with *D. rotundata* (419.60) is significantly higher those of *C. esculenta* and *D. alata* (Table III).

Table III: Macronutrients Contents of "Ikokore" Meals Prepared with Yam Species (g) and Derivable Calorie from Carbohydrate only (Kcal)

Macronutrients	***D. rotundata***	***C. esculenta***	***D. alata***
Moisture	364.20 ± 0.04[a] (72.84%)	363.00 ± 0.86[a] (72.60%)	372.90 ± 0.02[b] (74.58%)
Ash	9.00± 0.01[a]	12.15 ± 0.02[b]	13.65 ± 0.00[c]
Protein	8.20 ± 0.04[a]	9.60 ± 0.06[b]	11.05 ± 0.02[c]
Fibre	5.45 ± 0.04[a]	4.10 ± 0.02[b]	3.80 ± 0.01[c]
Fat	8.25 ± 0.02[a]	11.25 ± 0.01[b]	5.70 ± 0.04[c]
Carbohydrate	104.90 ± 0.00[a]	99.90 ± 0.01[b]	92.90 ± 0.00[c]
Derivable calorie*	419.60	399.60	371.60

Results are expressed as means ± SD, n = 5, p < 0.05
*Calorie (Kcal) derivable from carbohydrate only).

Table IV: Mineral Contents of "Ikokore" Meals Prepared with Three Different Yam Species (100 g/ppm)

Elements	***D. rotundata***	***C. esculenta***	***D. alata***
Chloride (Cl)	414.00 ± 0.00[a]	414.00 ± 0.00[a]	414.00 ± 0.00[a]
Potassium (K)	4.983 ± 149.00[a]	2.659 ± 0.042[b]	4.710 ± 0.126[c]
Calcium (Ca)	-		0.893 ± 0.053
Iron (Fe)	2216.834 ± 100[a]	582.891 ± 22.06[b]	90.00 ± 0.00[c]
Chromium (Cr)	-	6.442 ± 0.629	
Manganese (Mn)	-	-	-
Copper (Cu)	-	-	993.524 ± 32.364
Zinc (Zn)	598.725 ± 32.405[a]	-	1600.758 ± 71.940[b]

Results are expressed as means ± SD, n = 5, p < 0.05

The Potassium (4.983 ± 149.00 g/ppm) and iron (2216.834 ± 100 g/ppm) contents were significantly higher in porridge prepared with *D. rotundata* compared with *C. esculenta* and *D. alata* species. Calcium and copper were present in the porridge of *D. alata*, although the calcium was in trace amount but were not detected in the porridges of the remaining two species. Zinc was not detected in porridge from *C. esculenta*. Manganese was not detected in all the three porridge (Table IV).

Discussion

The importance of moisture in nutrition cannot be exhausted. Among so many functions, water is involved in digestion, reproduction, circulation and metabolism [6]. Intake of foods containing moisture will decrease burns in stomach, flushed skin, dry mouth, heat intolerance and muscle spasm [7]. Large percentage of moisture contents of these "ikokore" meals are expected since cooking is always done with reasonable amount of water. In addition, the yam species used in preparing the meals are naturally rich in moisture. Therefore, these health problems mentioned above may be prevented in the consumers of these meals. However, high moisture content has been associated with the lowering of shelf life of food [3] because owning to their water contents, microorganisms can easily grow on them. This may be one of the reasons why "ikokore" (porridge) has very short shelf life.

Fat content in the body helps in keeping the body temperature warm and also plays an important role in building the membranes that surround our cells [8]. Quantities of fats in the analysed "ikokore" meals were not surprising because palm oil was used in the preparation of these meals. However, the amount of oil used may vary from individuals, hence, leading to variation in fat contents of different "ikokore" meals.

Diets low in fibre, have been linked to dozens of medicinal problems including heart disease, cancer, diabetes mellitus and gall stone [9]. High-fibre diets can help control obesity and constipation; reduce the risk of cancer development and lower blood cholesterol [1]. Furthermore, fibre provides roughages which aids digestion in the body. Therefore, fibre has little nutritional value in its own right, but considered to have beneficial effects on health. The fibre contents of "ikokore" were low compared with the recommended dietary allowance [10, 11, 12, 13]. Therefore, consumers may suffer some of the ailments associated with fibre deficiency if they feed solely on "ikokore" meals.

Dietary proteins are compounds that build and repair body tissues. The body uses protein for energy only if carbohydrate and fat intake are insufficient. Thus protein is mostly in form of enzymes, rather than acting as a storage pool [6]. In addition, protein serves as antibodies, which help to fight against invasion in the body [14]. Therefore, this low amount of protein may impair the immune system and other protein-related metabolisms of group of people who feeds solely on the meals.

Ash content of a meal determines the quantity of minerals present in that meal. Minerals are responsible for maintenance of life [7]. The ash contents of these meals may have been improved by direct addition of salt during the preparation. However, the amount may vary from individuals since the addition of salt and other condiments to foods during cooking depends on the individuals' taste [15]. Potassium (K) helps to control the body water balance and regulates processes such as nerve transmission, muscle contraction and normal heart rhythm [7, 8]. Calcium (Ca) influences bone growth during childhood and adolescence [9]. Children who depends on the consumption of a lot of "ikokore" meal prepared with *D. rotundata* and *C. esculenta* as a sole source of calcium, may be defected in bone growth/formation if not complemented/supplied from another source. The presence of iron (Fe) in *D. rotundata* (2216.834ppm) and *C. esculenta* (582.891 ppm), which are higher than what has been reported earlier [16] is of great interest because high Fe content has been reported to induce the haemolysis of mammalian erythrocyte (red blood cells) where humans with sickle cell (SS) have the highest susceptibility [17]. However, iron may serve as a good source for the treatment of anaemia and deficiency in hemoglobin [14]. Copper (Cu) has been reported to help in proper functioning of erythrocytes in the body [18]. Therefore, functions of erythrocytes in people who depend solely on porridges ("ikokore" meals) prepared with *D. rotundata* and *C. esculenta* for source of copper (Cu) may be impaired since these yam species lack this mineral. Zinc has been reported to play a role in collagen synthesis and protein formation in the brain [7, 19]. Therefore consumption of "ikokore" meals prepared with *C. esculenta* may suffer malformation of collagen and brain protein. Chromium (Cr) is known to enhance the action of insulin, a hormone critical to the metabolism and storage of carbohydrate,

fat and protein in the body [19, 20]. Hence, the sole consumers of "ikokore" meals prepared with *D. rotundata* and *D. alata* may suffer insulin malformation, hence, malfunction in carbohydrate storage. Manganese, zinc and chromium are also necessary as co-factors in many enzymes without which, these enzymes may not properly carry out their numerous functions in metabolisms. In addition, manganese is required by animals and is believed to be essential for humans. For examples, manganese functions as a cofactor for a number of enzymes involved in urea, cholesterol, fatty acid biosynthesis and in protein, carbohydrate and energy metabolism [6]. Therefore, "ikokore" prepared with these yams are not a good source of manganese as it was not detected in these meals prepared from all three yam species. It has been reported that chloride serves as fluid regulator between cells and cell layers [14].

CONCLUSSION

The proximate analysis of "ikokore" meals prepared with *D. rotundata, C. esculenta* and *D. alata* revealed the presence of reasonable amount of macronutrients, major and trace minerals. Furthermore, these meals lack some major and trace minerals, the absence of which may impair normal development and growth of humans that solely feed/depend on the meals.

Acknowledgement

The Technologists in the Department of Biochemistry, Faculty of Science, Federal University Oye-Ekiti are acknowledged for their supports during this research.

The authors declared that no funds, grants or other support were received for conducting this study.

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CONFLICT Of INTEREST

The authors of this manuscript declare that there are no conflicts of interest and that we have no financial or personal relationship with any organisation which could influence the work.