

## Nutritive Quality Evaluation and Antinutrient Properties of Six Indigeneous Dishes of Igala Tribe of Kogi-State

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**Abstract:** Six indigenous dishes of Igala tribe of Kogi State were prepared from locally produced food items which include: majorly, maize, plantain, benin seed, barbara nut, bitter leaf and their functional properties determined. These dishes were subjected to evaluation for their protein, moisture, ash contents, some minerals, some vitamins (A, B<sub>1</sub>, B<sub>12</sub>, E, K) and sensory properties. The results revealed that oil and water absorption capacities of the dishes range from 5.2.33-84.00 (i.e., 12.7-20.3%) and 56.33-74.67 (14.5-19.2%), respectively. Whereas zinc and calcium ranged from 0.35-0.53 (13.9-20.7%) and 2.22-7.83 (9.2-32.5), respectively Iron, Phosphorus and Selenium: 0.48-0.59 (14.5-17.9%), 0.32-0.56 (12.6-22.1%) and 0.36-1.74 (6.2-30.1%), respectively. The vitamin contents of the food stuff peaked with the mean/% values of 1.51 (21.5% Vit. B<sub>1</sub>), 5.65 (25.3% Vit. A), 2.92 (30.9% Vit. E), 0.41 (17.8% Vit. B<sub>12</sub>) and 1.00 (18.0% Vit. K) in dishes D (Oboigogo), F (Epi-abo), E (Oboafu), C (Oboakpa) and A (Fayaba), respectively. The range values of the antinutrients in the six dishes on the other hand are phytate: 3.29-4.33 (14.4-19.0%); oxalate: 3.42-5.46 (14.1-22.6%) and tannin: 1.72-3.48 (11.8-23.9%). The results of the sensory evaluation carried out revealed that there were no significant differences ( $p > 0.05$ ) ( $F_{\text{tab. } 0.05, \text{DF}=4/25} = 2.76$ ,  $F_{\text{cal.}} = 1.13$ ) in terms of appearance, flavour, aroma and palatability and all the six dishes were generally acceptable to the panelists/consumers. The baseline data recorded in this research would undoubtedly, serve not only as a guide but detailed documentation of indigenous dishes of Igala tribe of Kogi State, Nigeria.

**Key words:** Dishes, functionality, quality evaluation, maize, plantain, barbaranut, benin-seed

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### INTRODUCTION

Nigeria is blessed with incredible variety of nutritious and wholesome food stuff. Currently, foods are evaluated based on their contents of energy, protein, vitamins, minerals and other nutrients (Cobley and Steale, 1976). Olaibi opined that food is integral parts of life which is used as a physiological, sociological and psychological function of life. Nigeria is a nation with ethnically and culturally diverse food consumption patterns in the different agro ecological zones. The diet of the people is based on the foods produced or marketed in the different zones. Akinyele (2007), in his opinion stated that urbanization however has created changes in food consumption pattern with more processed foods being available in cities. Olaibi on the other hand, opined that traditionally prepared Nigerian dish has no standard recipe procedure for the preparation and cooking, hence there is no good presentation and complementation of these indigenous foods. Ponka *et al.* (2005), however was of the view that there were defined methods of preparation and nutritional evaluation of dishes consumed by given set of people.

Akinyele (2007) stressed that there was thus an increasing need for more complete, accurate, reliable data on the nutrient contents and nutritional values of foods taken as meals. Greenfield and Southgate (2003) identified the significance of food and nutrient composition as essential in terms of quantitative study of human nutrition and stressed that food composition are used primarily for the assessment and the planning of human energy and nutrient intakes. Edible vegetables have been recognized as vital component of human diet that should be eaten all year round (Aliyu and Morufu, 2006). Malnutrition due to protein-calorie deficiency has been associated with nutritional pathology (Ponka *et al.*, 2005). The latter workers recorded protein content of leafy vegetables ranging from 20.48-41.66% D.W.

Sensory evaluation of food products/dishes is an important criterion by which its consumers' acceptability can easily be assessed (Samuel *et al.*, 2006). Nutrient compositions of Nigeria foods in this region are scarce and the available literature of Nigeria foods by Oguntona and Akinyele (1995) contains data on only few dishes. Although, some researchers have reported values on the proximate and certain micronutrients such as iron,

zinc, copper (Ene-Obong and Madukwe, 2001) including an anti-nutrient, phytate for dishes served traditionally at home but not all dishes from South-East Kogi State. This study was designed, therefore to determine proximate analysis, functional properties, some vitamins, minerals and anti-nutrient contents of six selected dishes from this region.

These indigenous dishes include Fayaba, Ogidigbo, Oboakpa, Obo-igobo, Obo-afu, Epi-abo of Igala tribe of Kogi State. Local food commodities were used effectively in the production of these dishes. The main objective is to prevent the gradual extinction of many indigenous foods from the modern Nigeria homes and to provide correct nutritional data on the nutritional contents of six commonly consumed dishes of South-East Kogi State, Nigeria. These are Fayaba, a plantain (*Musa paradisaca*) and corn base dish; Ogidigbo, a corn (*Zea mays*) corn base, Obo-akpa served with Oje-akpa a corn base, Oboigogo served with pounded yam a benin-seed (*Sesamum indicum* L.) soup, Obo-afu. Olaibi opined that traditionally prepared Nigerian dish has no standard recipe procedure for the preparation and cooking hence there is no good presentation and complementation of these indigenous foods with pounded yam (*Dioscorea esculanta*), fish with bitter leaf (*Vernonia amygdalina*) and Epi-abo a barbara nut (*Voandzeia subterranea*) base dish.

## MATERIALS AND METHODS

**Source of materials:** The yellow variety of maize (*Zea mays*) grains, plantain (*Musa paradisaca*), white yam (*D. rotundata*), Benne seed (*Sesamum indicum* L.), Locust bean (*Parkia Filicoidea*), Spinach (Amaranth), bitter leaf (*Vernonia amygdalina*), Ugu leaves (*Telferia accidentalis*), fresh tomatoes, grass cutter, fresh red peppers, dry fish, chicken, beef, crayfish, onion, salt, palm oil and magi were purchased from a local market in Idah town, Kogi State, Nigeria.

**Method of Steaming Maize and Plantain:** The 400 g of dry yellow corn was broken into grits from the mill. It was cleaned, winnowed, washed in cold water and soaked for 24 h. This was washed out and milled to a smooth past. The one finger (300 g) of over very ripe plantain was also roughly milled. Both were mixed together, portioned in leaves, wrapped and steamed for one and an half hours. It was checked and additional water was added and steamed for another 30 min. It was removed, unwrapped and served hot with fish vegetable sauce to the panelists.

**Method of Steaming Maize Pudding:** The 500 g yellow variety of corn was thoroughly washed. The 50 g fresh pepper, 100 g onions was added and all ingredients milled to a smooth paste. The 200 g frozen fish was boiled in salt

and onion water. After which was deboned. The 50 g vegetable was washed and shredded. The milled ingredients to it, salt, warmed palm oil, the deboned fish and the shredded vegetable was whisked to a fluffy texture. A ladle of 250 mL was used to portion into the leaves, wrapped and steamed for 1 h. It was served hot to the panelists.

**Method of Steaming Maize Stew:** The 200 g of yellow variety of corn was cleaned, lightly toasted in a pot and later broken into even sizes like fine garri. The 400 g of chicken was cleaned, portioned, placed into a thick bottom pan, 5 g salt, 10 g onion added and brought to boil. The broken corn was boiled for 30 min then to it milled pepper, onion, palm oil and the boiled chicken added. It was left to stew for 20 min. Checking for the salty-less and adding the 50 g of washed shredded spinach. It was allowed to simmer for another 15 min. It was served hot with corn/cassavas mould to the panelists.

**Method of Stewing Benne Seed Stew:** The 400 g of beef was cleaned and washed. It was brought to boil with addition of 10 g onions and pinch of salt to cook till tender. The dry fish was washed and deboned and kept aside. After in a clean pot added the ground pepper, onion, locust beans the beef and stock. This mixture was brought to boil. The washed and deboned dry fish was added. The ground benne seed was incorporated and allow to simmer for 30 min. Open and stir, the washed shredded pumpkin leaves and palm oil was added. It was covered and allowed to simmer for another 20 min. Stirred again and was served hot with pounded yam to the panelist.

**Method of Stewing Barbara-Nut Pottage (*Voandzeia subterranea*):** The 200 g of barbara-nut flour was sieved. The 10 g onions were chopped and placed aside. The 500 g of dry fish was washed and deboned, the rest 10 g onion, 50 g of fresh tomatoes, 5 g locust beans and 20 g cray fish were blended together. The twelve and half centilitres of palm oil was warmed, the chopped onion added and allowed to sweat for 5 min. The rest of the ingredient was added and allowed stewing for 20 min. The powdered nut was mixed into paste with 100 mills of liquid (stock/water). To the stewing stock, the dry fish and the paste which has been made into noodle shape was added. The pot was covered and allowed to simmer for 30-50 min. The spinach was shredded and added to the stew, stirred and corrected the seasonings. It was served hot and eaten by the panelists.

**Method of Stewing White Yam Stew:** The 400 g of grass cutter was washed, portioned, parboiled with 10 g onion

and pinch of salt for 20 min. The 50 g of yam was peeled, washed and added to the stock and allowed to cook without the game (that is the game was removed) for 20 min. The yam was removed and turned into mashed yam and placed aside. To the rest of the stock, another 200 mL of water was added, 20 g of ground pepper, 20 g onions, 20 g cray-fish, 5 g locust beans and maggi cube. All was brought to boil. The washed 50 g better leaf, the mashed yam and the boiled game meat was incorporated. The mixture was brought to boil and allowed to stew for 10 min. Seasoning was corrected and served with pounded yam to the panelists.

**Sensory evaluation of prepared dishes:** A panel of twenty judges randomly selected from staff and students of the Hospitality Department was used for the sensory evaluation as described by Ihekoronye and Ngoddy (1985). The judges evaluated the dishes for appearance, flavour, aroma, palatability and over all presentation on a four point scale (4 = very good, 3 = good, 2 = fair, 1 = unsatisfactory). The sensory evaluation was conducted under standard restaurant condition. The order of presentation of samples to the panels was randomized.

**Statistical analysis:** Sensory scores were subjected to analysis of variance (Steel and Torrie, 1980). Least score were separated by Least Significant Difference (LSD at  $p = 0.05$ ).

**Evaluation of functional properties:** Packed bulk density (Okaka and Porter, 1977), least gelation concentration (Sathe *et al.*, 1982), foaming capacity at 1 min and foam stability (Yatsumatsu *et al.*, 1972). Water and oil absorption capacities (Sosulski *et al.*, 1987) were determined.

**Chemical and physical evaluation:** The micro Kjeldahl technique for protein ( $N \times 6.25$ ), moisture (hot-air oven at  $105^\circ\text{C}$  and drying to constant weight) ash was determined by heating the sample in a muffle furnace at  $600^\circ\text{C}$  for 2 h, fat by means of soxhlet extraction method. Crude fibre was determined by heating the samples with acid and alkaline. Carbohydrate was determined by difference. The minerals and vitamins were determined using the atomic absorption spectrophotometer. The antinutrients was determined by High-Performance Liquid Chromatography (HPLC).

**Data analysis:** The data from chemical analysis were analyzed using mean and standard deviation (mean $\pm$ SD of 3 determinations).

## RESULTS AND DISCUSSION

Table 1 shows that the mean scores of the six dishes did not differ significantly ( $p > 0.05$ ) with respect to

Table 1: Mean sensory scores of the six dishes of Igala tribe of Kogi State, Nigeria

Dishes	*Sensory attributes				
	APD <sup>a</sup>	FLD <sup>b</sup>	ARD <sup>c</sup>	PLD <sup>d</sup>	PRD <sup>e</sup>
A	3.7	3.5	3.6	3.7	3.4
B	2.9	3.1	3.1	3.1	2.8
C	3.6	3.1	3.8	3.9	3.5
D	3.8	3.5	3.4	3.9	3.5
E	3.4	3.8	3.5	3.8	3.6
F	3.6	3.3	3.3	3.2	3.3

Evaluated on a 4 point hedonic scale (4 = very good; 3 = good; 2 = fair; 1 = unsatisfactory); <sup>a</sup>Appearance of dishes; <sup>b</sup>Flavour of dishes; <sup>c</sup>Aroma of dishes; <sup>d</sup>Palatability of dishes; <sup>e</sup>Presentation of dishes. Means sensory scores were not significantly different ( $p > 0.05$ ) between attributes assessed

appearance, flavour, aroma and palatability. All these dishes were generally acceptable to the panelists. The results revealed that the functional properties of the dishes per 100 g edible portions, the highest emulsion, oil absorption, water absorption capacities and emulsion stability were exhibited by mean/% values of 1.28 (17.7%), 84.00 (20.3%), 74.67 (19.2%) and 14.3 (18.1%) in dishes C (Oboakpa-corn soup), D (Oboigogo-beninseed soup), B (Ogidigbo-corn base product) and A (Fayaba-corn and ripe plantain blend), respectively. Whereas the least mean/% values of these functional properties were exhibited by mean/% values (in the same order) of 1.09 (15.1%), 52.33 (12.7%), 56.33 (14.5%) and 1.18 (14.9%) of in dishes D, A, E (Oboafu-corn base white soup devoid of oil) (Table 2). Generally, the oil and water absorption capacities of the dishes range from 52.33-84.00 (i.e., 12.7-20.3%) and 56.33-74.67 (14.5-19.2%), respectively. In the same vein, emulsion capacity and stability range from 1.09-1.28 (15.1-17.7%) and 1.18-1.43 (14.9-18.1%), respectively (Table 2).

Table 3 shows the mean/percentage (%) values and standard deviation of proximate analysis/properties of food stuff used in preparation of six dishes of Igala tribe, Kogi State, Nigeria. Proximate analysis showed that moisture, fat, ash, protein, fibre and carbohydrate (CHO) contents of the food stuff were the highest with mean/% values of 17.15 (18.3%), 18.00 (21.6%), 2.46 (36.1), 11.51 (28.9%), 0.78 (18.6%) and 14.58 (26.6%) in dishes A (Fayaba), C (Oboakpa), D (Oboigogo), E (Oboafu), A (Fayaba) and B (Ogidigbo), respectively. In the same order of nutritive values of the food stuff listed above, the least mean/% values of 61.41 (15.1%), 11.22 (13.5%), 0.45 (6.6%), 3.94 (9.9%), 0.65 (15.0%) and 3.34 (6.1%) occurred in dishes B (Ogidigbo), A (Fayaba), B (Ogidigbo), F (Epi-abo) and E (Oboboafu), respectively (Table 3). In general, moisture and fat contents in the six dishes ranged from 65.33-74.15 (16.1-18.3%) and 11.22-18.00 (13.5-21.6%), respectively ash and protein: 0.45-2.46 (6.6-26.1%) and 3.94-11.51 (9.9-28.9%), respectively and fibre and carbohydrate (CHO): 0.63-0.78 (15.0-18.6%) and 3.34-14.58 (6.1-26.6%), respectively.

Table 2: Mean and percentage (%) values and standard deviation of functional properties of food stuff used in preparation of six dishes of Igala tribe, Kogi State, Nigeria

Dishes	Functional properties			
	Emulsion capacity	Emulsion stability	Oil absorption capacity	Water absorption capacity
A	1.235±0.004 (17.0)	1.427±0.002 (18.1)	52.333±2.517 (12.7)	66.667±1.528 (17.2)
B	1.164±0.002 (16.0)	1.408±0.003 (17.8)	66.667±2.082 (16.1)	74.667±1.528 (19.2)
C	1.285±0.003 (17.6)	1.236±0.003 (15.7)	74.000±3.606 (17.9)	60.000±3.000 (15.4)
D	1.098±0.002 (15.1)	1.386±0.002 (17.6)	84.000±1.000 (20.3)	66.667±2.082 (17.2)
E	1.230±0.002 (16.9)	1.175±0.003 (14.9)	71.000±1.528 (17.2)	56.333±1.528 (14.5)
F	1.243±0.003 (17.1)	1.256±0.002 (15.9)	65.000±3.215 (15.7)	64.333±3.215 (16.6)
Total	7.262	7.888	413.000	388.667

Table 3: The mean/percentage (%) values and standard deviation of proximate analysis/properties of food stuff used in preparation of six dishes of Igala tribe, Kogi State, Nigeria

Dishes	Food stuff					
	Moisture	Fats	Ash	Protein	Fibre	CHO
A	74.15±0.00 (18.3)	11.22±0.00 (13.5)	0.45±0.00 (6.60)	4.81±0.00 (12.1)	0.78±0.00 (18.6)	8.80±0.45 (16.0)
B	61.41±0.00 (15.1)	11.41±0.00 (13.7)	1.00±0.01 (14.7)	3.94±0.00 (9.90)	0.64±0.00 (15.3)	14.58±0.01 (26.6)
C	70.60±0.00 (17.4)	18.00±0.00 (21.6)	0.55±0.00 (8.10)	4.82±0.00 (12.1)	0.72±0.00 (17.2)	5.16±0.24 (9.4)
D	63.73±0.00 (15.7)	15.61±0.21 (18.7)	2.46±0.00 (26.1)	8.32±0.00 (20.9)	0.74±0.00 (17.7)	9.15±0.22
E	70.41±0.00 (17.4)	13.63±0.00 (16.4)	1.65±0.00 (24.2)	11.51±0.00 (28.9)	0.68±0.00 (16.2)	3.34±0.40 (6.1)
F	65.33±0.00 (16.1)	13.41±0.00 (16.1)	0.71±0.00 (10.4)	6.43±0.00 (16.1)	0.63±0.00 (15.0)	13.85±0.00 (25.2)

Table 4: Mean and percentage (%) values and standard deviation of minerals present in food stuff used for preparation of six dishes of Igala tribe, Kogi State, Nigeria

Dishes	Minerals				
	Zinc	Calcium	Iron	Phosphorus	Selenium
A	0.53±0.00 (20.7)	2.22±0.00 (9.2)	0.56±0.00 (17.0)	0.38±0.00 (15.4)	0.36±0.00 (6.2)
B	0.41±0.00 (16.0)	4.63±0.00 (19.2)	0.48±0.00 (14.5)	0.56±0.00 (22.1)	0.48±0.00 (8.3)
C	0.39±0.00 (15.2)	7.83±0.01 (32.5)	0.54±0.00 (16.7)	0.32±0.15 (12.6)	1.12±0.00 (19.3)
D	0.35±0.00 (13.9)	3.44±0.00 (14.3)	0.54±0.00 (16.4)	0.39±0.00 (15.4)	1.12±0.00 (19.3)
E	0.41±0.00 (16.0)	3.29±0.06 (13.7)	0.59±0.00 (17.9)	0.42±0.00 (16.6)	0.97±0.00 (16.8)
F	0.47±0.00 (18.4)	2.67±0.00 (11.1)	0.58±0.00 (17.6)	0.45±0.00 (17.8)	1.74±0.00 (30.1)
Total	2.56	24.08	3.30	2.53	5.79

Table 5: Mean values and standard deviation of vitamins present in food stuff used for preparation of six dishes of Igala tribe, Kogi State, Nigeria

Dishes	Vitamins				
	B <sub>1</sub>	A	E	B <sub>12</sub>	K
A	1.28±0.00 (18.3)	1.31±0.00 (5.9)	1.56±0.00 (16.5)	0.39±0.00 (17.0)	0.99±0.00 (17.8)
B	1.04±0.00 (14.4)	2.49±0.00 (11.2)	1.78±0.00 (18.9)	0.40±0.01 (17.4)	1.00±0.01 (18.0)
C	0.85±0.00 (12.1)	5.12±0.00 (22.9)	0.67±0.00 (7.1)	0.41±0.00 (17.8)	0.83±0.00 (14.1)
D	1.51±0.00 (21.5)	4.59±0.01 (20.6)	0.67±0.00 (7.1)	0.38±0.01 (16.5)	0.84±0.01 (15.1)
E	0.40±0.00 (20.0)	3.16±0.00 (14.2)	2.92±0.00 (30.9)	0.33±0.00 (14.3)	0.94±0.00 (16.9)
F	0.93±0.00 (13.3)	5.65±0.00 (25.3)	1.84±0.00 (19.5)	0.39±0.00 (17.0)	0.96±0.00 (17.3)
Total	7.01	22.32	9.44	2.30	5.56

± values show Mean±SD (%)

Table 4 shows that zinc, calcium, iron, phosphorus and selenium exhibited the highest mean/% values of 0.55 (20.7%), 4.63 (19.2%), 0.59 (17.9%), 0.56 (22.1%) and 1.74 (30.1%), respectively in dishes A (Fayaba), B (Ogidigbo), E (Oboafu), B (Ogidigbo) and F (Epi-abo), respectively. In the same order, the least mean/% values of 0.35 (13.7%), 2.22 (9.2%), 0.48 (14.5%), 0.32 (12.6%) and 0.36 (6.2%) of the minerals occurred in dishes (Oboigogo), A (Fayaba), B (Ogidigbo), C (Oboakpa) and A (Fayaba), respectively. The results revealed that zinc and calcium ranged from 0.35-0.53 (13.9-20.7%) and 2.22-7.83 (9.2-32.5), respectively; iron, phosphorus and selenium: 0.48-0.59 (14.5-17.9%), 0.32-0.56 (12.6-22.1%) and 0.36-1.74 (6.2-30.1%), respectively.

The vitamin contents of the food stuff peaked with the mean/% values of 1.51 (21.5% Vit. B<sub>1</sub>), 5.65 (25.3% Vit. A), 2.92 (30.9% Vit. E), 0.41 (17.8% Vit. B<sub>12</sub>) and 1.00 (18.0% Vit. K) in dishes D (Oboigogo), F (Epi-abo), E (Oboafu), C (Oboakpa) and A (Fayaba), respectively. The least values of these vitamins in the same order above are: 0.85 (12.1%, dish C), 1.31 (5.9%, dish A), 0.67 (7.1%, dishes C and D), 0.33 (14.3%, dish E) and 0.83 (14.1%, dish C) (Table 5).

The results showed that antinutrients namely, phytate, oxalate and tannin present in food stuff used attained the peak with mean/% values of 4.33 (19.0% phytate), 0.46 (22.6% oxalate) and 3.48 (23.9% tannin) which occurred in dishes E (Oboafu), D

Table 6: Mean values/% and standard deviation of antinutrients present in food stuff used for preparation of six dishes of Igala tribe, Kogi State, Nigeria

Dishes	Antnutrients		
	Phytate	Oxalate	Tannin
A	4.33±0.00 (19.0%)	5.46±0.00 (22.6%)	2.61±0.00 (17.9%)
B	4.10±0.00 (18.0%)	3.49±0.00 (14.4%)	1.72±0.00 (11.8%)
C	3.90±0.00 (17.1%)	3.64±0.00 (15.0%)	3.48±0.00 (23.9%)
D	3.46±0.00 (15.2%)	3.42±0.00 (14.1%)	2.41±0.00 (16.5%)
E	3.29±0.00 (14.4%)	3.43±0.00 (14.2%)	2.33±0.00 (16.0%)
F	3.74±0.00 (16.4%)	4.76±0.00 (19.7%)	2.03±0.00 (13.9%)
Total	22.82	24.2	14.58

± values show Mean±SD (%)

(Oboigogo) and B (Ogidigbo), respectively. The range values of these antinutrients in the six dishes are phytate: 3.29-4.33(14.4-19.0%); oxalate: 3.42-5.46(14.1-22.6%)and tannin: 1.72-3.48 (11.8-23.9%) (Table 6).

The results of the sensory evaluation carried out revealed that there were no significant difference ( $p>0.05$ ) in terms of appearance, flavour, aroma and palatability and all the six dishes were generally acceptable to the panelists (Table 1). Generally, the oil and water absorption capacities of the dishes range from 52.33-84.00 (i.e., 12.7-20.3%)and 56.33-74.67 (14.5-19.2%), respectively. This implies that the meals would be highly digestible and nutrients therein easily released for metabolic activities of the body. Besides, emulsion capacity and stability range of 1.09-1.28 (15.1-17.7%) and 1.18-1.43 (14.9-18.1%) which were recorded, respectively is an indication that the meals could easily be emulsified and stabilized (Table 2). The ranges of fat and carbohydrate (CHO) contents in the six dishes (11.22-18.00(13.5-21.6%)and 3.34-14.58 (6.1-26.6%) resp.) recorded in this research are within tolerable level for normal physiological function of the body and ideal for the Igala tribe since most of their staple foods viz corn, rice, sorghum, yam and cassava are carbohydrate base which when taken in excess could lead to diseased conditions such as obesity, diabetes and cardiovascular diseases. In the same vein, the ranges of ash and protein contents: 0.45-2.46(6.6-26.1%)and 3.94-11.51 (9.9-28.9%) recorded, respectively fall within normal range. Malnutrition due to protein-calorie deficiency has been associated with nutritional pathology (Ponka *et al.*, 2005). The latter researchers recorded protein content of leafy vegetables ranging from 20.48-41.66% D.W.

The results revealed that zinc and calcium ranged from 0.35-0.53 (13.9-20.7%) and 2.22-7.83 (9.2-32.5), respectively iron, phosphorus and selenium: 0.48-0.59 (14.5-17.9%), 0.32-0.56 (12.6-22.1%) and 0.36-1.74 (6.2-30.1%), respectively. The mineral contents of the six dishes are generally within tolerable level of normal physiological function of the body. The vitamin contents of the food stuff peaked with the mean/% values of

1.51 (21.5% Vit. B<sub>1</sub>), 5.65 (25.3% Vit. A), 2.92 (30.9% Vit. E), 0.41 (17.8% Vit. B<sub>12</sub>) and 1.00 (18.0% Vit. K) in dishes D (Oboigogo), F (Epi-abo), E (Oboafu), C (Oboakpa) and A (Fayaba), respectively. The high contents of these vitamins in the dishes are impressive for they help to prevent skin, eye and blood diseases. The range values of the antinutrients in the six dishes on the other hand are phytate: 3.29-4.33 (14.4-19.0%); oxalate: 3.42-5.46 (14.1-22.6%) and tannin: 1.72-3.48 (11.8-23.9%). Again, these are within tolerable level of normal physiological function of the body and in line with detailed studies by Munro and Bassir (1969) which reviewed that the possibility of this anti-nutrients poisoning in Nigeria from consumption of local fruits and vegetables is as remote as it in other parts of the world. FAO (1977) concluded that the quality of the phytate and oxalate in traditional foods of Northern Nigerian were below toxic levels though their role in preventing the proper utilization of calcium and phosphorus could be considerable. The baseline data recorded in this research would, undoubtedly, serve not only as a guide but detailed documentation of indigenous Dishes of Igala tribe of Kogi State, Nigeria.

## CONCLUSION

The study has shown that the six dishes from this region have good functional, proximate and anti-nutrient properties and therefore, strongly recommended for consumers on a sustainable basis. The results of the sensory evaluation carried out revealed that there were no significant differences ( $p>0.05$ ) in terms of appearance, flavour, aroma and palatability and all the six dishes were generally acceptable to the consumers.

## ACKNOWLEDGEMENTS

Researchers are sincerely grateful to I.A.A. Ejima (Ph.D) of Biological Sciences Department of Federal University of Technology, Minna, Niger State, Nigeria for proof-reading the manuscript of this study.

## REFERENCES

- Akinyele, I.O., 2007. Upgrading Nigeria's food composition database with under-utilized Nigerian traditional foods and recipes. Proceedings of the 31st Conference on National Databank, April 27, 2007, Washington, DC., USA.
- Aliyu, H.M. and A.I. Morufu, 2006. Proximate analysis of some leafy vegetables (Roselle, jute and bitter leaf). *Int. J. Food Agric. Res.*, 3: 11-12.

- Cobley, L.S. and W.M. Steale, 1976. An Introduction to the Botany of Tropical Crops. 2nd Edn., Longmans, London, UK., pp: 71-110.
- Ene-Obong, H.N. and E.U. Madukwe, 2001. Bioavailability of trace elements in south-eastern Nigerian meals and the effect of dietary components. *Niger. J. Nutr. Sci.*, 22: 4-22.
- FAO, 1977. Manuals of Food Quality Control: Food Analysis: Quality, Adulteration and Tests of Identity. FAO, Rome, Italy, pp: 1-19.
- Greenfield, H. and D.A.T. Southgate, 2003. Food Composition Data-Production. FAO Publishing Management Service, Rome, pp: 1-21.
- Ihekoronye, A.I. and P.O. Ngoddy, 1985. Integrated Food Science and Technology for the Tropics. Macmillian Publisher, London, UK.
- Munro, A. and O. Bassir, 1969. Oxalate in Nigerian vegetables. *West Afr. J. Biol. Applied Chem.*, 12: 14-18.
- Oguntona, E.B. and I.O. Akinyele, 1995. Nutrient Composition of Commonly Eaten Foods in Nigeria-Raw Processed and Prepared. Food Basket Foundation, Ibadan, Nigeria, pp: 6-56.
- Okaka, J.C. and N.N. Porter, 1977. Functional and storage properties of cowpea provider/wheat flour blend in bread making. *J. Food Sci.*, 42: 826-833.
- Ponka, R., E. Fokou, R. Leke, M. Fotso, J. Souopgui, M.B. Achu and B.F. Tchouanguep, 2005. Methods of preparation and nutritional evaluation of dishes consumed in a malaria endemic zone in Cameroon (Ngali II). *Afr. J. Biotechnol.*, 4: 273-278.
- Samuel, F.O., E.O. Ayoola and F.O. Ayinla, 2006. Chemical Analysis and consumer acceptability of tapioca fortified with soybeans. *Int. J. Applied Agric. Res.*, 3: 1-5.
- Sathe, S.K., S.S. Deshpande and D.K. Salunkhe, 1982. Functional properties of lupin seed (*Lupinus mutabilis*) proteins and protein concentrates. *J. Food Sci.*, 47: 491-497.
- Sosulski, F.W., E.N. Kasirye-Alemu and A.K. Sumner, 1987. Microscopic, nutritional and functional properties of cowpea flours and protein concentrates during storage. *J. Food Sci.*, 52: 700-706.
- Steel, R.G.D. and J.H. Torrie, 1980. Principles and Procedures of Statistics. 1st Edn., McGraw-Hill, New York.
- Yatsumatsu, K., K. Sawada, S. Moritaka, J. Toda and K. Ishii, 1972. Whipping and emulsifying properties of soybean products. *Agric. Biol. Chem.*, 362: 719-727.