

# Nutritional Food Composition Analysis of Some Traditional Foods in Jigawa, Nigeria.

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**Abstract:** *Traditional foods constitute an important part of the culture, history, identity, heritage and local economy of a region or country and are key elements for the dietary patterns of each country. This research was conducted in Jigawa State Nigeria. A total of 1,500 questionnaires were administered and 1,250 were returned. Based on the analysed questionnaires, three representative samples of traditional foods which includes most prepared Tuwon Masara (white maize), moderately prepared Danwake and least Moimoi from the selected population were collected and transported to the laboratory for chemical food composition analysis. Standard procedures of AOAC were used to determine the carbohydrate content, crude protein, crude fat, ash, moisture content, total fiber, energy (kcal), glycosides, oxalate, phytate, tannin and total phenol. Based on the result obtained, these locally prepared foods are found to have high percentage of carbohydrate content, crude protein, fiber, moisture and energy than the recommended limit of Dietary Recommended Allowance (DRA). This may be attributed to lack of standard procedure on the actual amount of nutrients for the local populace.*

**Keywords:** Traditional food, carbohydrate, nutrients, composition analysis

## 1. Introduction

Traditional foods constitute an important part of the culture, history, identity, heritage and local economy of a region or country and are key elements for the dietary patterns of each country. These foods are commonly perceived as foods that have been consumed locally or regionally for a long time and the methods of preparation of such foods have been passed from generation to generation. Although the term 'traditional foods' is widely used, there are few definitions available [1, 2]. Two projects funded under the European Commission Framework Programme and the European Food Information Resource (EuroFIR), Network of Excellence and Traditional United Europe Food (TRUEFOOD), have been dealing with the concept of traditional foods. EuroFIR defined traditional food based on its types as a food of a specific feature or features, which distinguish it clearly from other similar products of the same category in terms of the use of 'traditional ingredients' (raw materials or primary products) or 'traditional composition' or 'traditional type of production and/or processing method'. The definition was extended comprises a description of the terms 'traditional ingredients', 'traditional composition' and 'traditional type of production and/or processing' [3]. From a consumer's perspective, Guerrero *et al.* [4] in TRUEFOOD defined a traditional food product as 'a product frequently consumed or associated with specific celebrations and/or seasons, normally transmitted from one generation to another, made accurately in a specific way according to the gastronomic heritage, with little or no processing/manipulation, distinguished and known because of its sensory properties and associated with a certain local area, region or country' [2].

According to Egan *et al.* [5], nutritional composition data are an essential resource for health researchers and epidemiologists who investigate the relationship between food and disease in populations and require an accurate estimation of nutrient intake, and are also the basis for the development of dietary recommendations. Nutritional composition data for traditional foods are also necessary to elucidate their role in the traditional dietary pattern of a

population. Some traditional foods and patterns may have potential health properties that have been tested over time [3, 6] and, in recent years, consumers have shown an increased interest and demand for traditional foods as they are often perceived as having specific sensory characteristics and being of higher quality [4, 7, 8].

This research paper will present a comprehensive food composition data of some common traditional foods in Jigawa state Nigeria with emphasis of traditional ingredients as well as their health implications. However, some suggestions on the preventive measures on these regards were discussed.

## Study Area

Jigawa State is in the North western part of Nigeria between latitudes 11.00°N to 13.00°N and longitudes 8.00°E to 10.15°E. It was created out of the old Kano State in August 1991 and has a total population of 4,348,649 inhabitants [9]. About 80 per cent of the population is found in the rural areas and predominately farmers and Muslims. The socio-cultural situation in Jigawa State could be described as homogeneous: it is mostly populated by Hausa/Fulani, who can be found in all parts of the State.

## 2. Material and Method

### Sample size and Sample Collection

A mixed questionnaire (open and closed) in both local language (Hausa) and English were used as an instrument for data collection. A clustered sampling method was strictly adhered to, in which the whole Jigawa state was divided into three clusters based on the three senatorial districts of the state. A total of 1,500 questionnaires were administered to the population of 4,348,649 (500 to each senatorial district) in which 1,250 were returned. Based on the filled questionnaires, three representative samples of traditional foods which includes most prepared food (*Tuwon Masara*), moderately prepared (*Danwake*) and least prepared (*Moimoi*) foods from the population were selected, collected and transported to the laboratory for chemical food composition analysis.

**Food Composition**

Food composition of locally prepared *Tuwon masara* (maize) with *Kuka* (baobab leaves) soup, *Danwake* and *moimoi*. For *Tuwon masara*, ingredients include maize (*Masara*), baobab leaves (*kuka*), African locust bean seeds (*daddawa*) and meat for *Tuwon masara*. Beans (*wake*), Groundnut oil (*mangyada*), Guinea corn (*dawa*), pepper baobab leaves (*kuka*), potash and cassava for *Danwake* while that of *moimoi* includes some ingredients such as beans, onion, and pepper. For comparison purposes, same foodstuffs with their ingredient were purchased from local markets in Jigawa, Nigeria and prepared in accordance with standard procedure.

**Chemical Analyses**

Standard procedures of AOAC were used to determine the carbohydrate content, crude protein, crude fat, ash, moisture content, total fiber, energy (kcal), glycosides, oxalate, phytate, tannin and total phenol [10]. Energy value was calculated using the Atwater's conversion factors (Spackman, 1958). Minerals were determined by a Zeeman Polarized Atomic Absorption Spectrophotometer, Hitachi Model 180-80, and Ion Chromatographic Analyzer ICA model IC 100 [11]. All reagents for the analysis of food are of analytical grade according to the specification of the manufacturers

**Statistical analysis**

Results were expressed as mean ± standard deviation. The difference between groups of each parameter was determined using the t-test and statistical significance were claimed at P<0.05.

**3. Result**

The proximate nutrient composition of most prepared local diet called white maize (*Tuwon masara*) and its recipes are presented in Table 1. The results indicated that total carbohydrate, crude protein, fiber, fat, moisture and energy

values are higher than what is recommended by Dietary Recommended Allowance value (DRA) in table 5 and well as value obtained from prepared food in table 4. Other recipes such as tannin, glycosidase, ash content, total phenol, oxalate and phytate indicate a high value from most prepared food (*Tuwon masara*) collected from selected sites than the one prepared in the laboratory.

Table 2 and 3 shows the percentage Proximate and Anti-Nutritional Content of Recipe for Moderately Selected Diet (*Danwake Served with Groundnut Oil and Pepper*) in (g/100g) and the percentage proximate and anti-nutritional contents in (g/100g) of the Recipe for Least Selected Diet *Bean cake (moimoi)* Consumed in Jigawa State, Nigeria respectively. From these tables, it was also observed that there is a high percentage of carbohydrate, crude protein, fiber, fat, moisture and energy values than the prepared food in the laboratory (table 4) as well as what is recommended by Dietary Recommended Allowance value (DRA) in table 5.

Table 4 is the percentage (g/100g) proximate and Anti Nutritional Content of three Prepared Selected Diets Consumed in Jigawa State, Nigeria. This table indicate the prepared food in the laboratory which was used to compare the three selected foods collected from different areas of the state and analysed in the laboratory. The control food shows a lower percentage of carbohydrate, crude protein, fiber, fat, moisture and energy values as well as tannin, glycosidase, ash content, total phenol, oxalate and phytate when compared with the values in table 1, 2 and 3 for *Tuwon Masara*, *Dan Wake* and *MoiMoi* respectively.

From table 5, percentage proximate and anti-nutritional content of the three locally prepared foods which includes total carbohydrate, crude protein, fat content, fiber and moisture content were compared with Dietary Recommended Allowance (DRA). Details of these contents show that locally prepared foods have higher percentage values than recommended limits.

**Table 1:** Percentage (g/100g) proximate and Anti-Nutritional Contents of Recipe for most commonly selected Diet (*Tuwon Masara (white) Served with Kuka Soup*) Consumed in Jigawa State, Nigeria

Parameters Sample	Carboh-Ydrate	Crude protein	Crude Fat	Crude Fiber	Moisture	Ash	Energy (kcal)	C. glycosides (mg/100g)	Oxalate (mg/100g)	Phytate	Tannin	Total Phenols
Maize (white)	84.0300 ± 1.4042	8.4778 ± 1.2945	0.2764 ± 0.0022	0.3617 ± 0.0823	6.5000 ± 0.2236	0.2542 ± 0.0340	372.1667 ± 0.9458	0.1250 ± 0.0010	3.2633 ± 0.1050	1.1951 ± 0.0177	0.1602 ± 0.0049	14.6849 ± 1.4585
Baobab	63.0754 ± 2.7174	17.6889 ± 2.3411	0.2762 ± 0.0054	10.4975 ± 0.7862	6.3333 ± 0.4216	2.2296 ± 0.0187	325.6667 ± 3.1269	0.4220 ± 0.0130	7.8833 ± 0.0883	1.6089 ± 0.0496	0.5059 ± 0.0066	36.8128 ± 1.0375
Potash	17.4949 ± 0.1083	1.6722 ± 0.0717	0.2969 ± 0.0120	0.6142 ± 0.0266	6.3333 ± 0.3333	73.7385 ± 0.2955	79.3405 ± 0.8280	0.1130 ± 0.0000	0.9900 ± 0.0942	0.4061 ± 0.0310	0.0281 ± 0.0038	0.3364 ± 0.0213
Onion	72.6134 ± 1.3581	4.1222 ± 0.2144	0.3056 ± 0.0139	11.8175 ± 1.4136	10.6667 ± 0.2108	0.7079 ± 0.0305	309.8333 ± 5.6179	0.5340 ± 0.0040	45.7600 ± 0.8271	2.8155 ± 0.1947	0.3783 ± 0.0187	10.3760 ± 0.5955
Daddawa	41.8349 ± 5.4149	30.6833 ± 5.4435	0.2702 ± 0.0012	14.9725 ± 0.1905	11.0000 ± 0.0000	1.2057 ± 0.0351	292.5000 ± 1.1475	0.1680 ± 0.0020	22.2200 ± 1.0303	1.1448 ± 0.0272	0.3478 ± 0.0135	16.1065 ± 0.0288
Meat	30.4242 ± 6.9736	57.4333 ± 9.2501	0.2784 ± 0.0101	3.3071 ± 2.7349	7.5714 ± 0.4286	0.8998 ± 0.1018	363.3333 ± 0.8028	0.1490 ± 0.0010	9.1300 ± 0.3150	0.3558 ± 0.0285	0.0978 ± 0.0075	15.2998 ± 0.1255

Hot pepper	54.0580 ± 0.4917	4.0600 ± 0.5351	0.2949 ± 0.0122	33.1200 ± 0.1420	6.8000 ± 0.2000	1.6671 ± 0.0132	236.6667 ± 1.5635	0.1970 ± 0.0130	30.4700 ± 0.8814	1.6437 ± 0.0202	0.4230 ± 0.0162	19.5647 ± 0.9893
Total for white maize	363.5299 ± 18.4682	124.1377 ± 19.1504	1.9982 ± 0.0570	74.6505 ± 5.3761	55.2047 ± 1.8179	80.7028 ± 0.5288	1979.5072 ± 14.0324	1.7080 ± 0.0340	119.7166 ± 3.3413	9.4731 ± 0.3689	1.9411 ± 0.0712	113.1811 ± 4.2564

**KEY: Values are mean ± SE, n = 6, key: c/protein, c/fat c/fiber and c/glycosides: cyanogenic glycosides, T/phenol: Total phenol**

**Table 2: Percentage (g/100g) Proximate and Anti-Nutritional Content of Recipe for Moderately Selected Diet (Danwake Served with Groundnut Oil and Pepper) Consumed in Jigawa State**

Parameters Sample	Carbohydrate	Crude Protein	Crude Fat	Crude Fiber	Moisture	Ash	Energy (kcal)	C. Glycosides (mg/100g)	Oxalate (mg/100g)	Phytate	Tannin	Total Phenol
Guinea corn	84.7872 ± 0.9806	7.3889 ± 0.9614	0.2761 ± 0.0057	0.5142 ± 0.0057	6.8333 ± 0.1667	0.3336 ± 0.1667	371.3333 ± 0.3333	0.122 ± 0.001	4.0333 ± 0.1940	1.4774 ± 0.0622	0.1492 ± 0.0007	5.5221 ± 0.2387
Cassava	90.1854 ± 0.1846	1.1278 ± 0.1746	0.2747 ± 0.0027	0.4975 ± 0.0312	7.3333 ± 0.2108	0.5479 ± 0.0290	367.6667 ± 0.5578	0.133 ± 0.001	2.9700 ± 0.2028	0.2823 ± 0.0202	0.1535 ± 0.0011	4.9696 ± 0.9829
Beans	29.7399 ± 3.4482	61.0944 ± 3.3616	0.2774 ± 0.0020	1.3517 ± 0.2952	6.8333 ± 0.1667	0.8366 ± 0.0664	366.0000 ± 1.2383	0.124 ± 0.000	7.0400 ± 0.2664	0.7812 ± 0.0279	0.3348 ± 0.0112	3.7275 ± 0.3659
Baobab	63.0745 ± 2.7174	17.6889 ± 2.3411	0.2762 ± 0.0054	10.4975 ± 0.7862	6.3333 ± 0.4216	2.2296 ± 0.0187	325.6667 ± 3.1269	0.422 ± 0.013	7.8833 ± 0.0883	1.6089 ± 0.0496	0.5059 ± 0.0066	36.8128 ± 1.0375
Pepper	42.6425 ± 1.8415	16.7222 ± 1.5344	0.3118 ± 0.0156	33.0267 ± 1.0431	4.5000 ± 0.2236	2.8802 ± 0.5887	240.3333 ± 3.252	0.246 ± 0.006	17.7100 ± 0.2588	1.4194 ± 0.0430	0.2909 ± 0.0046	22.4932 ± 1.5294
Potash	17.4949 ± 0.1083	1.6772 ± 0.0717	0.2969 ± 0.0120	0.6142 ± 0.0266	6.3333 ± 0.3333	73.7385 ± 0.2955	79.3405 ± 0.8280	0.113 ± 0.000	0.9900 ± 0.0942	0.4061 ± 0.0310	0.0281 ± 0.0038	0.3364 ± 0.0213
Total	327.9244 ± 9.2806	105.6944 ± 8.4448	1.7131 ± 0.1838	46.5018 ± 2.2258	38.1665 ± 1.5227	80.5664 ± 1.0341	1750.3405 ± 9.3366	1.1610 ± 0.0210	40.6266 ± 1.1045	5.9753 ± 0.2339	1.4624 ± 0.0280	73.8616 ± 4.1757

**Values are mean ± SE, n=6**

**Table 3: Proximate and Anti Nutritional Contents(g/100g) of the Recipe for Least Selected Diet Bean cake (moimoi) Consumed in Jigawa State, Nigeria**

Parameters Sample	Carbohydrate	Crude Protein	Crude Fat	Crude Fiber	Moisture	Ash	Energy (kcal)	C. Glycosides (mg/100g)	Oxalate (mg/100g)	Phytate	Tannin	Total Phenol
Beans	29.7399 ± 3.4482	61.0944 ± 3.3616	0.2774 ± 0.0020	1.3517 ± 0.2952	6.8333 ± 0.1667	0.8366 ± 0.0664	366.0000 ± 1.2383	0.125 ± 0.000	7.0400 ± 0.2664	0.7812 ± 0.0279	0.3348 ± 0.0112	3.7275 ± 0.3659
Onion	72.6134 ± 1.3581	4.1222 ± 0.2144	0.3056 ± 0.0139	11.8175 ± 1.4136	10.6667 ± 0.2108	0.7079 ± 0.0305	309.8333 ± 5.6179	0.534 ± 0.004	45.7600 ± 0.8271	2.8155 ± 0.1947	0.3783 ± 0.0187	10.3760 ± 0.5955
Hot pepper	54.0580 ± 0.4917	4.0600 ± 0.5351	0.2949 ± 0.0122	33.1200 ± 0.1420	6.8000 ± 0.2000	1.6671 ± 0.0132	236.667 ± 1.5635	0.197 ± 0.013	30.4700 ± 0.8814	1.6437 ± 0.0202	0.4230 ± 0.0162	19.5647 ± 0.9893
Total	156.4113 ± 5.2980	69.2766 ± 4.1111	0.8779 ± 0.0281	46.2892 ± 1.8508	24.3000 ± 0.5775	3.2116 ± 0.1101	912.5000 ± 8.4197	0.8560 ± 0.0170	83.2700 ± 1.9749	5.2404 ± 0.2428	1.1361 ± 0.0461	33.6682 ± 1.9507

**Values are mean ± SE, n=6**

**Key: c/protein: crude protein, c/fat c/fiber and c/glycosides: cyanogenic glycosides, T/phenol: Total phenol**

**Table 4: Percentage (g/100g) proximate and Anti Nutritional Content of three Prepared Selected Diets Consumed in Jigawa State, Nigeria**

Parameters Sample	Carbohydrate	Crude Protein	Crude Fat	Crude Fiber	MOISTURE	ASH	Energy (kcal)	Glycosides (mg/100g)	Oxalate (mg/100g)	Phytate	Tannin	Total phenol
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Tuwon masara (white) with kuka soup	75.6261 ± 1.3068	6.9222 ± 0.5705	7.6172 ± 0.0195	5.2713 ± 0.9015	3.4833 ± 0.1400	1.0799 ± 0.0569	398.7483 ± 3.7884	0.00062 ± 0.00002	0.00272 ± 0.00007	0.19338 ± 0.01576	0.28943 ± 0.00380	9.82897 ± 0.04062
Danwake with groundnut oil and pepper	54.4385 ± 0.6526	23.7111 ± 0.7164	12.1733 ± 0.5809	2.5755 ± 0.3367	5.9667 ± 0.0667	1.1348 ± 0.0059	422.1586 ± 1.9777	0.00020 ± 0.00000	0.00192 ± 0.00012	0.12763 ± 0.00847	0.29083 ± 0.00374	7.24345 ± 0.35784
Moimoi	53.7884 ± 1.4505	18.8111 ± 2.0265	16.7789 ± 0.4112	3.5441 ± 0.7754	5.3667 ± 0.1453	1.7108 ± 0.0051	441.4079 ± 2.8876	0.00022 ± 0.00002	0.00203 ± 0.00004	0.11216 ± 0.00774	0.31323 ± 0.00304	9.37227 ± 0.02553

Values are mean ± SE, n=6

Key: c/protein: crude protein, c/fat c/fiber and c/glycosides: cyanogenic glycosides, T/phenol: Total phenol

**Table 5:** Total Proximate and Anti Nutritional Contents(g/100g) of the Recipes for all Selected Diets Consumed in Jigawa State, Nigeria

Total Food composition	<i>Tuwon masara</i>	<i>Dan wake</i>	<i>Moimoi</i>	RDA Recommended (g/d)
Carbohydrate	363.53±18.46	327.90±9.20	53.78±1.45	60-120
Crude protein	124.13±19.15	105.69±8.40	18.81±2.03	9.1-71.0
Fat	1.99±0.05	1.70±0.18	16.78±0.41	31.0
Fiber	74.65±5.37	46.50±2.20	3.54±0.77	19-38
Moisture	55.20±1.81	38.16±1.50	5.36±0.14	0.7-3.8
Ash	80.70±0.52	80.56±1.03	1.71±0.01	
Energy (kcal)	1979.51±14.03	1750.30±9.30	441.40±2.89	
Glycosides (mg/100g)	1.71±0.03	1.16±0.02	0.00±0.00	
Oxalate	119.72±3.34	40.62±1.10	0.00±0.00	
Phytate	9.47±0.34	5.97±0.23	0.11±0.01	
Tannin	1.94±0.07	1.46±0.02	0.31±0.00	
Phenol	113.18±4.26	73.86±4.17	9.37±0.03	

Key: Values are mean ± SE, RDA= Recommended Dietary Allowance, g= gram, d=day

#### 4. Discussion

From this study, it is clear that most prepared, moderate and least prepared local food analysed in this study area have high percentage nutritional contents of carbohydrate, crude protein, fat, fiber, and moisture content as compared to the same types of food prepared using standard procedure as well as (RDA) standard [12]. These high contents in the diet can be attributed to improper addition of recipes before, during and after processing which lead to micronutrient content of plant-based diets as reported by [13, 14, 15].

A diets consisting of cereals and legumes mixed with some animal protein source, have been reported to be sufficiently high in amino acids to meet RNI's (Recommended Nutrient Intakes) [16]. For instance, in table 1 (*Tuwon Masara* (white) Served with *Kuka* Soup) which contained about some percentage of meat showed higher crude protein contents than the other two diets, which is the base agreement in line with above mentioned observation. Furthermore, table 1,2 and 3 above contained higher amount of crude protein content. This can be attributed to the higher percentage of plant protein recipes such as beans in addition to animal protein (meat) mentioned above.

The quality of these local foods may be affected by their high moisture contents. Temple *et al* [14] state that high moisture content in foods encourage microbial growth. This is necessary looking at the fact that local foods in Nigeria are prepared in high quantities and are normally kept for some time. It is in our view that local food be prepare in a small quantity and use at that particular time so as to avoid prolonged storage which in turn allow growth of pathogenic microbial flora [17].

The fat contents of these three local diets *Tuwon masara*, *Danwake* and *moimoi* (1.99±0.05, 1.7±0.18 and 16.78±0.41) respectively are lower than DRA limit of 31.0. high fat in *moimoi* followed by *Danwake* can be attributed to the use of ground nut oil in a high concentration than in *Tuwon masara*. This attribute tends to agree with the recommendations of FAO/WHO (1998) that groundnut or vegetable oils be included in all foods, which will not only increase the energy density, but also be a transport vehicle for fat soluble vitamins. The fat can also provide essential fatty acids like that of n-3 and n-6 Polyunsaturated Fatty Acids (PUFA's) needed to ensure proper neural development as supported by [18]. The Food and Agricultural Organization and the World Health Organization have also recommended that foods should be energy-dense ones. This, according to the recommendation, is necessary because low energy foods tend to limit total energy intake and the utilization of other nutrients as mentioned above.

#### 5. Conclusion

This study revealed that most prepared, moderate and least locally processed food in Jigawa state Nigeria can meet some required nutrients for consumption. However, certain nutritional requirements are higher than the maximum requirement set aside by Food and Agricultural Organisation (FAO) and as such did not make a balanced diet. Therefore, fortification with appropriate micronutrients or micronutrient-dense foodstuffs is necessary.

This result recommends that proper method on the amount of recipes to be use by local populace will ultimately improve the quality of food there by preventing food related diseases like diabetes, obesity and malnutrition. This is believed to be a practical food-based approach aimed at combating the

problem of malnutrition among Jigawa state populace in particular and Nigeria at large. Further study is in locally processed food is necessary so as to address the anti-nutritional factors, as well as the bioavailability of macro and micronutrients in an effort to provide food containing all the available nutrients in a balance proportion.

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## References

- [1] Jordana J (2000): Traditional foods: challenges facing the European food industry. *Food Res Int* 33, 147–152.
- [2] Costa, H.S., Vasilopoulou, E., Trichopoulou, A. and Finglas, P. (2010): New nutritional data on traditional foods for European food composition databases; *European Journal of Clinical Nutrition* 64, S73–S81.
- [3] Trichopoulou A, Soukara S, Vasilopoulou E (2007): Traditional foods: a science and society perspective. *Trends Food Sci Technol* 18, 420–427.
- [4] Guerrero L, Guardia MD, Xicola J, Verbeke W, Vanhonacker F, Zakowska-Biemans S et al. (2009). Consumer-driven definition of traditional food products and innovation in traditional foods. A qualitative cross-cultural study. *Appetite* 52, 345–354
- [5] Egan MB, Fragodt A, Raats MM, Hodgkins C, Lumbers M (2007). The importance of harmonizing food composition data across Europe. *Eur J Clin Nutr* 61, 813–821
- [6] Trichopoulou A, Vasilopoulou E, Georga K, Soukara S, Dilis V (2006): Traditional foods: why and how to sustain them. *Trends Food Sci Technol* 17, 498–504.
- [7] Chambers S, Lobb A, Butler L, Harvey K, Traill WB (2007): Local, National and imported foods: a qualitative study. *Appetite* 49, 208–213.
- [8] Pieniak Z, Verbeke W, Vanhonacker F, Guerrero L, Hersleth M (2009): Association between traditional food consumption and motives for food choice in six European countries. *Appetite* 53, 101–108
- [9] National Population Commission (NPC, 2006): Population of Jigawa state Nigeria. [www.jigawastate.gov.ng](http://www.jigawastate.gov.ng)
- [10] AOAC (1990): Official Methods of Analysis – 15 th ed. Association of Official Analytical Chemist., Washington D.C.
- [11] Spackman DH, Stein EH and S (1958): Moore Automatic Recording Apparatus for use in the Chromatography of Amino acids. *Analytical Chemistry*; 30: 1190 –1191
- [12] National Research Council Recommended Dietary Allowance. 10 th ed. Washington DC: National Academy Press. 1989.
- [13] Nnam NM (2002): Evaluation of Complementary Foods based on Maize, Groundnut, Pawpaw and Mango Flour Blends. *Nig. J. Nutr. Sci*; 22(23): 8 – 18.
- [14] Mariam S. (2005): Nutritive value of three potential complementary foods based on cereals and legumes; *African Journal of Food and Nutritional Sciences*; 5:(2), 1-14.
- [15] Temple VJ, Badamosi EJ, Ladeji O and Solomon M. (1996): Proximate Chemical Composition of three Locally Formulated Complementary Foods. *West Afr. J. Biol. Sci.* 5: 134 – 143.
- [16] FAO/WHO (1998): Preparation and use of Food-Based Dietary Guidelines. Report of a Joint FAO/WHO Consultation. WHO Technical Report series 880. Geneva.
- [17] Badamosi EJ, Ibrahim LM and VJ (1995): Temple Nutritional Evaluation of a locally formulated Weaning food, JUTH-PAP. *West Afr. J. Biol. Sci.* 3: 85-93.
- [18] Fernandez DE, Vanderjagt DJ, Williams M, Hwang YS, Chuang Lut-te, Millson M, Andrew R, Pastuszyn A and Glew RH (2002): Fatty acids, amino acids, and trace mineral analyses of five weaning foods from Jos, Nigeria. *Plants foods for Human Nutrition*; 57: 257-274