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### Comparing and Contrasting Three Cultural Food Customs from Nigeria and Analyzing the Nutrient Content of Diets from These Cultures with the Aim of Proffering Nutritional Intervention

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**Comparing and Contrasting Three Cultural Food Customs from Nigeria and Analyzing the Nutrient Content of Diets from These Cultures with the Aim of Proffering Nutritional Intervention**

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*Nigeria is a multicultural country with a diverse cultural food. Most Nigerians' cultural diet is based on staple food accompanied by stew. In the South West and Eastern region (where Yorubas and Igbos are the dominant ethnic groups), staple foods are yam and cassava by-product (garri, fufu and lafun) with vegetables prepared as stew, often over cooked, thereby losing essential micronutrients. In Northern Nigeria (where the Hausas and Fulanis are the dominant ethnic groups), grains such as sorghum, millet form the main diet; these are served with palm oil based soup made with tomatoes and okra. Meat is sometimes added. Among the Hausas, meat is usually reserved for special occasions. The various types of malnutrition prevalent in developing countries such as Nigeria are Iron deficiency anaemia (ID/A), Protein–Energy Malnutrition (PEM), Vitamin A deficiency (VAD), Iodine Deficiency Disorder (IDD). The proposed long term measure by the Federal government of Nigeria for the resolution of these various types of malnutrition is dietary diversification. A review of the literature on*

*Nigerian cultural diets identified gaps in knowledge with respect to the nutritional values of Nigerian ethnic diets.*

**Keywords:** Nigeria diets, culture, malnutrition, developing countries.

## ***INTRODUCTION***

United Nations definition of Western Africa includes the following sixteen (16) countries however this is a recent construct and it may be that for the cultural and dietary practices it is necessary to understand the history of the region, the Ghanaian and Malian Empires for example.

The sixteen (16) countries are Benin, Gambia, Liberia, Nigeria, Burkina Faso, Ghana, Mali, Senegal, Cape Verde, Guinea, Mauritania, Sierra Leone, Ivory Coast, Guinea-Bissau, Niger and Togo. These countries have a common cultural history possibly from the period of the Ghanaian or Malian Empires. There has been increasing diversification since that period. The diets across the region have a number of common aspects. Nigeria is one of the major countries in the region and has a complex and diverse culture which derives from the regions ancient history and may therefore be representative of the entire region. This may be a significant advantage in that by developing a nutritional policy for Nigeria it may have applicability across the wider region.

Nigeria is divided into 36 provinces for administrative purposes however for the purposes of the study reported here regional areas, (South West)-Yorubas, North West (Northerners)-Hausa/Fulanis and (South East)-Igbos have been used as these more closely approximate to the regional dietary habits.

Nigeria is a multicultural country with a diverse culture and diets partially because of the diverse ethnic origin, social and agricultural profile. There has been movement of people from one region to another and this has led to diets originally associated with a particular ethnic group in a particular region being consumed by other ethnic group in another region and this development

has caused changes in cultural food in the various regions. Few states are affected in the different regions; an example of a state affected in the South Western region is Lagos State, the former capital of Nigeria. Lagos State is a great cosmopolitan city with virtually all tribes and ethnic group represented and therefore food consumed in Lagos state may be multicultural diets which may likely cut across all regions. The majority of the inhabitants of a particular region should however reflect the ethnic food culture except in few cosmopolitan states such as Abuja (the present capital of Nigeria), Port Harcourt (the oil city) and Lagos (former capital of Nigeria), to mention a few.

Most Nigerians' basic diet is based on staple local foods accompanied by a vegetable stew (Culture of Nigeria, 2013). The local staples vary considerably. In the South West and Eastern region (where Yorubas and Igbo are the dominant ethnic groups), some of the staple foods (Table 1) are consumed with vegetables prepared as stew, often over cooked, thereby losing essential micronutrients.

In Nigeria, the terms stew and soup do not necessarily mean the same as the Oxford dictionary meaning of stew and soup. The Oxford dictionary meaning of the word *stew* means a dish of meat and vegetables cooked slowly in a liquid in a closed dish or pan: e.g. lamb stew; while the word *soup* means a liquid food made by boiling meat, vegetables, etc. in water, often eaten as the first course of a meal: e.g. a bowl of tomato/chicken soup. Unlike the western world, in Nigeria, there is no first, second or third course. The meal is served once as a single course except in few ceremonial occasions where snacks are served prior to the main meal (Table 1). The main meal is usually eaten in the afternoon (Culture of Nigeria, 2013).

Usually in Nigeria, the stew or soup are called by their local names and stew is often prepared as soup which will only be served in a low income household where they cannot afford to add other ingredients such as meat, fish and vegetable (if vegetable stew). There are common local names for the different types of stew consumed by the three cultural groups (Table 1).

Most stews in Nigeria as a whole are cooked in palm oil with chicken, beef, goat meat, pork, snail, prawn (smoked dried milled prawn, smoked dried prawn, fresh prawn), tomatoes, fish, okra, ground lemon seeds, periwinkle (*Littorina saxatilis*), vegetables of various species. The type of stew made and the quantity of meat, fish or vegetable added depends on the level of affluence of the household.

In the morning, the meal consumed is usually light except the Igbos that consumed heavy meal (Table 1). *Ogi* (morning meal) is processed maize, the processing method will normally eliminate most micronutrients as it involves several stages such as soaking, milling, sieving, which will leach most micronutrients, such as vitamins, into the wash water. *Moinmoin* and *akara* (morning meal) are made from beans; however, the quantity of *moinmoin* or *akara* eaten depends on the level of affluence. A child from the low income group may be given *ogi* without *moinmoin* or *akara* because the family cannot afford to buy beans, while a child from an affluence home will be given enough *moinmoin* or *akara* to go with the *ogi*. Research work on *ogi* and methods employed in improving the nutrient content will be reviewed later in this paper. There is a large gap between the rich and the poor. The rich tend to be obese whilst the poor tend to be malnourished. Protein and micro nutrients are insufficient in the diets of the poor while the rich will have these in abundance. The poor tend to buy *orunla* (sun-dried okra) or other cheap low nutrient products and use it to make stew with little or no meat or fish whereas the affluent

can afford assorted meat, fish and vegetables to add to the stew and so their children will have healthier diets.

The fruits consumed by Nigerians will depend upon the region and the local agriculture. Commonly consumed fruits include papaya, mangoes, pineapple, oranges, grapes, cashew nut, avocado, guava and tomato. These fruits are stored traditionally in barns in their unripe form and this method does not preserve the fruit well enough to allow it to last until the next season. They are not adequately preserved (not chilled, frozen or canned) during transit to where they will be sold and so are not available out of season as they tend to deteriorate rapidly due to microbial and enzymatic reaction (Idah et al 2007). The shelf life depends on the type of fruit but for most it is relatively short varying between 4 days and one month. Fruit and vegetables have high moisture contents; they continue to respire after harvest (release and absorption of gases and other materials from the environment) which leads to deterioration during storage and transportation from where they are harvested to where they are to be sold. Deterioration becomes more pronounced during these stages (storage and transportation) because the Nigeria weather is hot (high temperature) and humid which is not favourable for the preservation of fruits and vegetable. Fruit and vegetables are grown in large quantities and eaten fresh but heavy losses are encountered because of inadequate preservation (Idah et al 2007). The harvest of these fruit is seasonal. Although fruit is not adequately preserved in Nigeria, some vegetables such as okra, *ugu* and other leafy vegetables are traditionally preserved but the method of preservation may not retain essential nutrients. Okra is a vegetable that is widely eaten in Nigeria (by the Hausas, Igbo and Yorubas) but it is not preserved under the right atmospheric conditions to maintain its freshness throughout season, nor is it frozen as chilling or freezing is rarely practiced by farmers

in Nigeria because of irregular supply of electricity. The availability of this vegetable is therefore limited out of season. Okra is traditionally preserved by slicing into pieces and sun drying it. In this form it is commonly called *ōorunlaö* in the South Western part of Nigeria. *Ugu* is traditionally preserved by allowing the leaves to de-hydrate naturally under the sun; the leaves are not sliced into pieces unlike okra pods. These vegetables (*orunla* and *ugu*) are then re-hydrated prior to use.

In the Northern Nigeria (where the Hausas and Fulanis are the dominant ethnic groups), grains form the main diet (see Table 1); these are served with oil based soup made with tomatoes and okra. Meat is sometimes added. Among the Hausas, meat is usually reserved for special occasions. Among the Fulanis, yoghurt and fresh milk are common though not refrigerated (Culture of Nigeria, 2013).

Food is traditionally eaten by hand, though with the influence of Western culture, cutleries are becoming common even in villages. Staple food such as *tuwo*, *amala* etc., (Table 1) is traditionally served in plates along with stew (Table 1). These meals are traditionally eaten by hand; the hand is used like a scoop while the temperature of the food is lukewarm. People in the urban are familiar with canned, pre-packed foods. This study will focus mainly on Nigeria local diets and not modern diets.

The various types of malnutrition prevalent in developing countries such as Nigeria are Iron deficiency anaemia (ID/A), Protein & Energy Malnutrition (PEM), Vitamin A deficiency (VAD which leads to increased risk of premature child mortality from infectious diseases and childhood blindness) and Iodine Deficiency Disorder (IDD) (FAO/WHO 1992e). Dietary diversification is the proposed long term measure by the Federal Government of Nigeria to the resolution of the



various types of malnutrition mentioned above; this has given birth to the concept of this research.

It is possible to change the various forms of malnutrition prevalent in developing countries such as Nigeria using the available food products without importing high nutritious food into the country but by changing dietary values, modifying the diets and changing cooking method. Various research carried out in this respect will be reviewed in this paper.

## ***NIGERIA GEOGRAPHICAL ZONES***

Nigeria is a multicultural country with six geographical zones (The North West, North East, North Central, South West, South East, South South) each having different diets. Some of these diets are not nutritious (mainly starchy food) while some are nutritious.

This research will focus on three cultural diets (from three cultural groups), diets for the **Hausa/Fulanis** cultural group (from the North West, representing the Northerners), the **Yorubas** cultural group (South West, representing the South Westerners) and the **Igbos** cultural group (from the South East, representing the South Easterners).

Nigeria has over 100 ethnic groups; however, these three groups were chosen as they are representatives of the majority of Nigerian dietary styles, and because Nigeria is a multi-ethnic society, analysing the diets in the entire multi-ethnic group will not be possible within the time frame of this research. In addition, choosing the Hausa/Fulanis from the North West is more like a balance of culture and history, even if there are differences, the majority are Muslims in terms of religion background, they grow similar crops, fruits and vegetables, and they are exposed to the same food and will eat very similar diet. An example is *koko* consumed by the Hausas

(Northwest) and other cultural groups, which is consumed with or without *kose* (called *akara* by the Yorubas) or *alala* (called *moinmoin* by the Yorubas) for breakfast (Table 1).

Imbalanced diets and non-nutritious cultural food has led to malnutrition which has been identified in Nigeria as silent killer in the country and thought to be responsible for over 60% of avoidable maternal and child deaths especially those children under five years of age (Onimawo, 2010).

### ***NIGERIA GAIN PROJECT***

The government has implemented the Nigeria GAIN (Global Alliance for Improved Nutrition) strategy aimed at tackling malnutrition, this strategy is being implemented in phases (Phase 1 and 2 projects), the co-author was involved in the Phase 1 project which was implemented by the National Agency for Food and Drug Administration and Control (NAFDAC) and ended in December 2007 (NAFDAC 2006). The GAIN phase 2 project started with the disbursement of funds to cover the cost involved in the approval of project activities identified to kick start this phase and by 2012, there was high level of compliance, well over 80 per cent (NAFDAC 2010; The Nigerian Voice 2012) .

Food fortification is being implemented in Nigeria, but a major challenge is the lack of adequate funding of small and medium scale industries to finance micronutrient premixes to be added to the packed food products. NAFDAC is thus encouraging companies that manufacture pre-mixes for the fortification of food such as vegetable oil, salt and flour to establish factories in Nigeria in order to reduce cost (Nigerian Compass 2010). This research will focus on diets prepared from

traditional raw materials such as cassava made into *lafun* (processed sun-dried, ground fine granular form, re-hydrated in boiling water prior to consumption), *fufu* (fermented cassava) and *garri* (processed sun-dried granular form) eaten by the South West and South East inhabitants. These traditionally made food products are cheaper to purchase by the less privileged than the refined fortified packaged products such as *õSemo-vitaö* (wheat flour made from technologically processed wheat). People who reside in the villages will eat traditionally processed food and not fortified westernised food products.

### ***GAIN AND NAFDAC FACTS FINDING MISSION***

The study carried out by the GAIN fact finding mission in Nigeria revealed that the major micronutrients deficiency affecting children and women are:

- a) VAD (Vitamin A Deficiency): In 1994, about 9.2% of children less than 5 years old were affected and 7.2% of women were affected. This varies based on geographical location, 2% in Southwest and 16% in Northwest.
- b) IDD (Iodine Deficiency Disorder): In 1993, about 20% were affected; the number came down to 11% in 1999. It caused grade 1.2 goitre. About 25 to 35 million Nigerians are at risk. Its deficiency during pregnancy and early childhood can cause irreversible impairment of brain development. Due to iodisation in Nigeria, IDD has reduced to 11%.
- c) IDA (Iron Deficiency Anaemia): About 29% of children are affected, 25% of mothers are also affected in Nigeria. In the Southeast, 61% of women are affected and 50% of children less than 5 years of age are affected. About one in five maternal deaths is due to

retardation, compromised mental development and poor physical activity. Reduced labour productivity has also occurred as a result of IDA (NAFDAC 2006).

### *Strategies utilised by the Federal Government of Nigeria*

The Federal Government of Nigeria (FGN) came up with supplementation routinely since 1996 as **short-term** measure or as part of immunisation since 1999. The **medium-term** measure is Food fortification with Vitamin A which commenced in 1996. Wheat and maize fortification started on the 1<sup>st</sup> of September 2002; while on the 1<sup>st</sup> of December 2002 sugar fortification was introduced then followed by vegetable oil in the same year. Dietary diversification is a **long-term** measure. It is the **medium-term** measure (see Table 2) that is related to NAFDAC while this research is more related to the **long-term** measure which is dietary diversification (NAFDAC 2006).

NAFDAC's major role in this medium-term measure is to ensure major compliance of factory, wholesale, retail and consumer levels as well as imported goods. NAFDAC has been involved in fortification since 1993. Beginning with salt iodisation; it monitors compliance at factory, wholesale, retail and consumer levels as well as imports. The strategies used by NAFDAC are staff development, in-house training; and ensuring materials and supplies are adequate for laboratory analysis (NAFDAC 2006).

NAFDAC further actualised these strategies on Vitamin A food fortification by carrying out survey to assess vitamin A levels in products, determining the stability after they had left the factory, determining the factors affecting the stability and proffering solutions.

***INTERNATIONAL PROJECTS ON NUTRITION***

Internationally, at the region level and country levels, there are a number of initiatives to improve nutrition outcomes such as “Repositioning Nutrition as Central to Development” by World Bank, the “Countdown to 2015” by the International Community to improve child survival through a reduction of children’s deaths which includes interventions, “REACH: Ending Child Hunger and Under-nutrition Initiative” by WFP and UNICEF; “The new 10 year Strategic Framework” by Global Alliance for Improved Nutrition (GAIN); and the recently established Micronutrient Forum (WHO 2010).

In a nutshell, the aim of this paper is to evaluate the Nigerian diets based on literature review and identify areas that need improvement for further research. On identifying areas that need improvement, further research work can be carried out which may involve the analysis of these diets and the results can be used in proffering solutions to malnutrition problem in Nigeria, combating HIV/AIDs, malaria and other diseases, improve maternal health (this is because women are mostly involved in cooking) and reduce child mortality which is also in line with Goals 4, 5 and 6 WHO’s Millennium Development Goals (MDGs) (WHO, 2010).

Malnutrition in Nigeria contributes to about 60% of the underlying causes of deaths that can actually be avoided, thus making Nigeria a country with one of the worst maternal and child death rates in the world (Onimawo 2010). There is a call for the review of the current national food and nutrition policy in Nigeria to include the emergence of severe to moderate acute malnutrition which was not been included in the current policy (Onimawo 2010). All children have the same potential to grow if adequate mother and child nutrition is ensured. One hundred

and seventy eight million (178,000,000) children under the age of five which represent about one third of children in developing countries are too short for their age (WHO 2010).

Malnutrition which is prevalent among pregnant and nursing mothers has increased mother-to-child-transmission rates (MTCT) of HIV (WHO, 2002a). About 60% of the ten million, nine hundred thousand (10.9) million mortality recorded yearly among children less than five years of age in the developing world is related to malnutrition (WHO, 2002a). The greatest preventable cause of mental retardation and brain damage worldwide is Iodine deficiency; this is estimated to affect more than seven hundred (700) million people, mostly in the developing countries (WHO, 1999). It is reported that over two (2) billion people have iron deficiency anaemia (WHO, 2001). Childhood blindness and increased risk of premature childhood death from infectious diseases is a result of Vitamin A deficiency. About two hundred and fifty (250) million children under the age of five are reported to be suffering from subclinical vitamin A deficiency (WHO, 2003). Malnutrition can therefore be devastating and can lead to death if not treated. People, who are malnourished visit doctors more often, have more complications and higher death rates than well-nourished people. Malnutrition does not occur overnight. It is fuelled by poverty and when combined with diseases that are infectious and chronic, the consequences include disability, stunted growth and death (WHO 2000b).

The immune system is weakened by malnutrition which increases the risk of ill health and subsequently aggravates malnutrition; this becomes a vicious cycle (Tomkins and Watson 1989; Semba and Tang 1999). Worldwide, approximately half of all preschool child deaths are associated with the negative impact of malnutrition and infectious diseases. Most of these deaths

are complicated by mild to moderate under-nutrition (Pelletier et al. 1994). Unbalanced diet can affect the immunity of the mucosal region and increase the risk of viral load in the genital tract (John et al.1997).

Obesity is not limited to Industrialised countries; children of the affluent in developing countries such as Mexico, India, Nigeria and Tunisia are increasingly overweight. An increase in obesity among this group (children) has occurred over the past 20 years in developing countries (WHO 2000a, De Onis and Blossner 2000).

Quite a number of households in Africa (Nigeria included) cannot access safe and quality food that is enough in terms of quantity to assuage their hunger. Food, nutrition, HIV/AIDS are interwoven and food insecurity increases susceptibility to HIV exposure and infection (Loevinsohn and Gillespie 2003).

Food safety is essential, it is linked to the microbiological environment which is represented by an individual's health and nutritional status and then on to the macro-environmental level of culture, economy and policy (Loevinsohn and Gillespie 2003). Poor quality, quantity and safety of food coupled with inadequate health services together with malnutrition may speed up the spread of HIV by increasing the risk of infection after exposure (Semba and Tang 1999).

There is a direct proportionality between food insecurity, poor health care and malnutrition rates. Malnutrition will invariably lead to HIV transmission efficiency by increasing susceptibility and lowering immunity which result in gut and mucosal integrity (WHO 2004).

Report of current literature review on severe malnutrition showed that there are still gaps in knowledge in various phases, in particular to feeding young infants who are living with HIV/AIDS and taking care of children living with HIV/AIDS (WHO 2004).

***GEOGRAPHICAL AND REGIONAL ZONES IN NIGERIA***

Nigeria is a multicultural country with six geographical zones. The six geographical zones consist of thirty six (36) states and the Federal Capital Territory (FCT) (see Table 3). There are four regional groupings even though there are six geopolitical zones. These are the North (North West, North East and North Central), South West, South East and South South (Nigeria Punch 2012).

***FOOD, DIET, NUTRITION AND CULTURE***

The outcome of a joint WHO/FAO expert consultation on Diet, Nutrition and Prevention of Chronic Diseases held in Geneva in 2002 showed that the increase in epidemic of chronic disease afflicting the developed and developing countries was related to diet and lifestyle (WHO 2003).

Epidemiological evidence based on population studies have also helped to show the effect of diet in the prevention and control of premature mortality and morbidity which occurred as a result of non-communicable diseases (NCDs). There has been identification of specific dietary components that increase the chances of occurrence of these diseases in persons and intervention to make their impact less severe; however, there is no specific dietary component identified in relation to Nigeria diets (WHO 2003). The individual dietary patterns, the geographical location of individuals in Nigeria, i.e. city/urban or village, the North, South South, South East and South West determines the type of food consumed (dietary pattern) and lifestyle.

Religious inclination, diet and lifestyle are also related to a large extent on the geographical location. The Northern part of Nigeria is predominantly dominated by the Muslims, the South South, South East and South West by Christian and Muslims. The Muslims are limited in their



choice of diet/food based on their religious belief. Muslims do not consume food such as Pork, Alcohol and non Halal food (Inter Islam 1998-2001). The term Halal simply means food permissible according to Islamic beliefs; this is also used in reference to food contact, pharmaceutical and food products. With reference to this review, emphasise will be on food products. Halal meat for example simply means meat slaughtered according to Islamic rights in which blood was allowed to flow out of the animal at slaughter and the name of Allah was invoked during slaughter of the animal. This means apart from pork, blood and alcohol, Muslims will consume every other food consumed by their Christian counterparts.

An individual living in the cities such as Lagos, Port Harcourt, Abuja etc. with a good job (middle class) will likely be exposed to Western world food, less exercise, less physically demanding manual tasks, sedentary lifestyle, automated devices at home etc.; all these lifestyles are related to diseases (obesity, diabetes, cardiovascular diseases, increase in the risk of colon cancer, osteoporosis, high blood pressure, lipids disorder, anxiety and depression) prevalent in these areas (WHO 2002b). In contrast, an individual living in the same environment without a job will be compelled to consume what she can afford and so tend to be malnourished, eating staple foods, mainly carbohydrate such as *Garri* and Bread (not as sandwiches), such an individual will have lower immunity and be more susceptible to malaria, HIV/AIDs etc.

Cultural diets and lifestyles are changing rapidly in developing countries; this has led to under nutrition and food insecurity in some parts and the chronic epidemic of obesity in conjunction with stroke, hypertension, diabetes and heart disease formerly limited to industrialized countries (WHO 2000a). In countries as diverse as Mexico, Nigeria, India and Tunisia, there is an increase in overweight amongst children over the past twenty (20) years. The increase in obesity in

developing countries is an indicator that lack of adequate exercise is becoming an issue in these countries as well (WHO 2000a).

Work done on developing nutrition intervention and guidelines from cultural diets associated with each culture and section of the country, Nigeria will be the focus of this literature review.

## ***NIGERIAN DIETS AND NUTRITION***

### ***Studies on ogi as a diet***

A study of weaning diets in Nigeria was carried out with a focus on *ogi*. *Ogi* is fermented cereal porridge, a popular weaning, convalescent and breakfast food in Nigeria. In this study, *Ogi* was made from different cereals as it is prepared locally in different parts of Nigeria. In the Southern Nigeria, *ogi* is made from white and yellow maize while in the Northern part of Nigeria; *ogi* is made from white and red Sorghum. The nutrient content of *ogi* made from maize and sorghum were compared with bread fruit and cassava. The result of the study showed that protein was 7.53 -9.28% in *ogi* compared to cassava starch which was 1.05% and breadfruit which was 8.05%. Sorghum *ogi* had the highest energy (4.07kcal/g) and fat content was highest in maize *ogi* (5.5%); however, protein digestibility was high for all diets (93.0-97.1 %) (Adewusi et al 1991).

A study was carried out on the prophylactic and therapeutic properties of *ogi* in order to proffer nutritional intervention to *Salmonella typhi* infection. Rabbits used in this study were classified into three groups and in three phases of the study (Aderiye and David 2013).

Rabbits in group one (the control group) were fed on commercial diets and not infected with *Salmonella typhi*.

Rabbits in group two were infected with *Salmonella typhi* at the second phase; fed on commercial diets at the second phase and *ogi* at the third phase.

Rabbits in group three were infected with *Salmonella typhi* at the second phase; fed with *ogi* at the second and third phase.

The result of the study showed that high loads of *Salmonella typhi* were present in group two rabbits (their faeces and blood) compared to group three rabbits. The results also showed that food intake and weight of group one rabbits were higher than group two and three rabbits (the experimental rabbits).

The least food intake was in group two while there was weight loss in group three. The white blood cells (WBCs) levels were also measured and the results showed that the level of WBCs in group 2 rabbits decreased from  $7300\text{mm}^3$  to  $6300\text{mm}^3$  compared to group 3 rabbits which decreased from  $4900\text{mm}^3$  to  $4200\text{mm}^3$ . It was therefore concluded that *ogi* could be effective in preventing *Salmonella* infection and decrease in the level of *Salmonella typhi* in the blood of mammals as indicated from the microbial and haematological indices (Aderiye and David 2013). This study proffered nutritional intervention to *Salmonella* infection using *ogi* but nutrient content of the *ogi* was not carried out unlike the studies carried on the comparison of nutrient content of *ogi* made from maize and sorghum with bread fruit and cassava (Adewusi et al 1991).

### ***Studies on cassava as a diet***

Several studies have been carried out on cassava as one of the food products consumed in Nigeria.

The IDRC Soybean Utilization Project, jointly implemented by IITA and national institutes in Nigeria, fortified cassava with soybean to reduce malnutrition problem caused by root crop based Nigerian/African diets (Osho 1994). The author was involved in this project. This project successfully developed several different uses for soybean in foods and disseminating this technology to rural and urban people.

A study of children consuming cassava as a staple food has shown that they are at risk of inadequate zinc, iron and vitamin A intake (Gegios et al 2010). Cassava is the primary staple crop of over 250 million Africans (Gegios et al 2010). This crop contains little iron, zinc or beta-carotene. The dietary diaries for 24 hours of children between age 2-5 years in Nigeria and Kenya were collated for 793 Nigeria children and 449 Kenya children. The results showed that among Nigeria children, 31% derived minimum of 25% dietary energy from cassava while among Kenya children, 89% derived minimum of 25% of dietary energy from cassava. Spearman's correlation coefficient between the fraction of dietary energy obtained from cassava and Vitamin A, iron and zinc intake were  $r = -0.15$ ,  $P < 0.0001$ ,  $r = -0.36$ ,  $P < 0.0001$  and  $r = -0.11$ ,  $P < 0.0001$  respectively. These results in comparison with Nigeria and Kenya children's vitamin A, zinc and iron consumption showed that 17% Nigeria children had adequate Vitamin A intake, 41% zinc and 57% iron whereas 59% Kenya children had adequate Vitamin A intake, 31% zinc and 22% iron. It therefore concluded that consumption of cassava poses risk of adequate zinc, Vitamin A and/or iron intake (Gegios et al 2010).

An assessment of exposure to cyanide in Nigeria and the evidence available although dependent on circumstances points to the fact that chronic cyanide poisoning mainly from cassava is the main cause of tropical neuropathy in Nigerians (Osuntokun 1980).

A study on the persistence of tropical ataxic neuropathy (TAN) in a Nigerian community, *Ososa*, *Ijebu* speaking *Yorubas* in South Western Nigeria (a community known to be endemic to TAN in 1969) was determined. The result was compared with Strachan's syndrome, the endemic neuropathy in Cuba and Konzo; and the outcome showed that the occurrence of TAN in *Ososa* has increased tremendously. The increase is linked to the consumption of cassava foods (Oluwole et al 2000).

A recent study on the possible effects of *garri*-based kwashiorkorigenic diet on renal function was investigated in a study carried out on albino rats (Olasore and Samuel 2010). *Garri* made from cassava, a staple food in many parts of Nigeria, is often consumed without it being supplemented with anything because of the prevailing level of poverty among the poor as they are unable to purchase these supplements which subsequently lead to malnutrition. Twenty four albino rats were divided into two groups; a group was fed with Low Protein Diet (LPD) while the other group was fed with Commercially Produced Diet (CPD) for eight weeks. The percentage weight change (% + SD) and the relative kidney weight for CPD and LPD groups were determined. Based on the results of the Blood Urea Nitrogen (BUN) ( $\text{mg dL}^{-1}$ ), serum creatine ( $\text{mgdL}^{-1}$ ) and the BUN/creatinine ratio which were  $93.42 \pm 6.68$ ,  $1.92 \pm 0.04$  and  $24.47 \pm 1.18$  in the LPD group and  $19.1 \pm 0.84$ ,  $0.81 \pm 0.11$  and  $24.47 \pm 1.18$  in the CPD group, it was concluded that during the chronic protein-energy malnutrition which occurred as a result of the consumption of poorly supplemented *garri*-based diet, some renal functions were compromised (Olasore and Samuel 2010). The various studies detailed above, carried out on cassava revealed that even though it is a staple food in Nigeria, its anti-nutritional factor (the presence of cyanide)

and its consumption when not supplemented with other diets rich in protein and other nutrients could lead to kwashiorkor and tropical ataxic neuropathy (Olasore and Samuel 2010).

The effect of processing on the total organic acids content and mineral availability of simulated cassava-vegetable diets in Nigeria showed fermented cassava had higher Calcium and Iron contents and lower Magnesium level than the unfermented cassava (Adewusi et al 1999). Zinc remained fairly constant in grated cassava but there was a reduction during steeping, a step which occurs during preparation for *lafun* and *fufu* production. The availability of these minerals was however witnessed during fermentation. The vegetable analysed with cassava in simulated cassava-vegetable diets was amaranth vegetable. The mineral content of amaranth vegetable decreased as a result of blanching but its availability increased during the same blanching process. It was concluded that blanching of amaranth vegetable and fermentation of cassava made minerals more available and these processes should be promoted in order to reduce the diseases associated with mineral deficiency (Adewusi et al 1999).

The study did not however consider the loss of water soluble vitamins as a result of blanching on vegetables and other micro nutrients coupled with the fact that there was reduction in Magnesium level due to fermentation and zinc during steeping. Although blanching of vegetables increases the availability of minerals; however, if considerable reduction had occur during blanching due to leaching, there would have been considerable reduction in the minerals and little quantity will be available afterwards.

### ***Studies on vegetables***

Study carried out on the leafy vegetables as a source of minerals in Southern Nigerian diets (the blanching process was not considered) showed that iron and zinc levels range between 1.4 to 12.3mg and 0.3 to 1.9mg per 100g fresh weight respectively and Calcium level ranges between 0.07 -0.28g per 100g fresh weight. It was concluded that Nigerian leafy vegetable contribute significantly to proportion of Iron, Zinc and Calcium in the traditional diet (Smith 1982).

The result of a study on the influence of heat processing on the nutrient composition of vegetable leaves consumed in Nigeria showed that cooking decreased the ash, crude fat, crude protein, ascorbic acid and the level of divalent minerals Magnesium, Zinc, Iron and Copper but increased monovalent metal such as Sodium in all the leafy vegetables analysed (Onyeike et al 2003). The samples of leafy vegetables were analysed. Moisture content in raw samples was in the range of 70.69% in hard leaf *óHL* (*ugu* leaf consumed in South East Nigeria) and  $93.29 \pm 0.11\%$  in water leaf -WL (*Hydrophyllum capitatum*). The highest ash content was  $5.9 \pm 0.09\%$  obtained in fluted pumpkin leaf (FPL), followed by  $3.20 \pm 0.33\%$  in HL and lowest in WL ( $1.22 \pm 0.07\%$ ). Green leaf (GL) had highest protein of  $5.32 \pm 0.05\%$  followed by HL  $4.87 \pm 0.08\%$  and lowest was WL  $1.68 \pm 0.31\%$ . There was significant loss in ascorbic acid to cooking water (Onyeike et al 2003).

### ***Studies on various other cultural diets***

A study on the beta carotene content of commonly consumed foods and soups in Nigeria was analysed as Vitamin A deficiency (VAD) is one of the various identified malnutrition in Nigeria (Sanusi and Adebisi 2009). The commonly available source of beta carotene is red palm oil used in cooking in all cultural settings in Nigeria.

Some commonly consumed soups (stew from Oxford dictionary definition as earlier explained under introduction) and foods were purchased from food vendors in three agro-ecological zones namely dry savannah, moist savannah and humid forest in Nigeria (see Table 4) (Akinyele 2007).

Beta Carotene in these foods and soup samples were extracted using a modified method and the contents determined using a JEN Way 6305 Ultra violet and visible spectrophotometer with a wavelength set at 450nm. The root/tubers and products were analysed for beta carotene per 100g food sample, the samples analysed were *eba/garri* (white), *eba/garri* (yellow), cassava flour (*lafun*), *fufu*, boiled yam, pounded yam, yam flour (*amala*) and yam pottage; the carotene ( $\mu\text{g}$ ) mean  $\pm$  SD contents were  $93.00 \pm 0.95$ ,  $321.00 \pm 0.57$ ,  $155.00 \pm 0.42$ ,  $6.00 \pm 0.71$ ,  $22.00 \pm 0.00$ ,  $97.00 \pm 0.64$ ,  $39.00 \pm 0.00$  and  $607.00 \pm 1.00$  respectively.

The cereals/grains and products were analysed for beta carotene per 100g food sample, the samples analysed were *eko /agidi* (yellow), *eko/agidi* (white), *ogi/pap* (yellow), *ogi/pap* (white), white rice, jollof rice, fried rice, *tuwo masara*, *tuwo shinkafa*; the carotene ( $\mu\text{g}$ ) mean  $\pm$  SD contents were  $180.00 \pm 0.13$ ,  $97.00 \pm 0.92$ ,  $221.00 \pm 0.85$ ,  $68.00 \pm 0.14$ ,  $68.00 \pm 0.33$ ,  $192.00 \pm 1.00$ ,  $379.00 \pm 0.01$ ,  $47.00 \pm 0.33$ ,  $122.00 \pm 0.92$  respectively (Sanusi and Adebisi 2009).

The results of cowpeas/beans and products analysed for beta carotene per 100g ( $\mu\text{g}$ ) mean  $\pm$  SD) food samples; *moinmoin* (red palm oil), *moinmoin* (veg oil), beans porridge, boiled beans, *akara* (red palm oil) and *akara* (vegetable oil) were  $8000.50 \pm 0.28$ ,  $387.00 \pm 1.13$ ,  $4257.00 \pm 0.98$ ,  $126.00 \pm 0.83$ ,  $3395.00 \pm 0.78$  and  $263.00 \pm 1.12$  respectively.

The soups and stew were analysed for beta carotene per 100g stew/soup sample, the soup samples analysed were *kubewa*, *kuka*, okra, *efo riro*, *ewedu*, *ogbonno*, oha and *egunsi* and *efo*



while the stew samples analysed were vegetable stew and palm oil stew; the carotene ( $\mu\text{g}$ ) mean  $\pm$  SD contents were;  $1369.00 \pm 1.09$ ,  $1676.00 \pm 1.09$ ,  $2786.00 \pm 0.33$ ,  $12976.00 \pm 0.00$ ,  $8378.00 \pm 0.14$ ,  $13134.00 \pm 0.31$ ,  $10299.00 \pm 1.07$  and  $13047.00 \pm 0.78$  respectively while the value for stew samples were  $6539.00 \pm 0.98$  and  $7872.00 \pm 1.00$  respectively (Sanusi and Adebisi 2009).

From the results detailed above, stews and soups had the highest value of beta carotene. Foods like bean porridge, yam pottage, *moinmoin* and *akara* prepared using red palm oil also had beta carotene in moderate quantity. Foods made from yellow maize such as *eko/agidi* (solid form) and *ogi/pap* (liquid form) had lower value of beta carotene. The beta carotene content ranged from 6  $\mu\text{g}$  /100 of food sample in *fufu* to 13, 279  $\mu\text{g}$  /100 of soup sample in *õedikang ikongö* soup (soup commonly eaten by the Calabars in the South South of Nigeria).

It was suggested that the result of this study should be added to Nigeria food composition data (Sanusi and Adebisi 2009). The present food composition table was compiled in 1995 (Oguntona and Akinyele 1995).

The long term solution proffered to ameliorate Vitamin A deficiency (VAD) in Nigeria is dietary diversification, the results of this study will enable Nigerians to know cultural diets that are rich in Vitamin A.

A similar study to the authors' present study was proposed in 2007 on upgrading the Nigeria's food composition database (Nigeria food composition database is the same as the present food composition table compiled in 1995) with under-utilised Nigerians traditional food and recipes (Akinyele 2007), as at the time the paper was presented, the study was facing the challenges of limited financial support to accomplish the project. One of the aims of this study was to recommend food combination that will ameliorate the risk of non-communicable diseases in

Nigeria and promote good health. It was stated in this study that there is an increasing need for more complete, reliable and accurate data on the nutritional value and nutrient content of foods than the information presently available in the Nigeria food composition table. Another aim of this study (Akinyele 2007) was to review and update the present food composition table in accordance with internationally accepted standards. One of the concepts was to prepare dietary guidelines based on nutrient composition of various recipes. The methodology was to involve scientist from different institutions located in all agro-ecological zone in undertaking this review. The samples to be analysed are cereals, roots and tubers, legumes while the next phase is to sample fruits and vegetables. This study is however not based on diet diaries of individuals from the agro-ecological zones but on obtaining samples from major markets in different states in Nigeria. The area covered were Enugu-Enugu State, (South East Nigeria), Uyo-Akwa Ibom (South South Nigeria), Ibadan-Oyo State (South West Nigeria), Jos-Plateau State (North Central Nigeria), Maiduguri-Borno State (North East Nigeria) and Lagos-Lagos State (South West Nigeria) unlike the authors' current study that is focused on three geographical zones which are North West, South West and South East. This study (Akinyele 2007) also focused on upgrading the Nigeria's food composition database but did not discuss bacterial and viral contamination in cultural diet.

The co-author of this study co-published a paper on the "Development and evaluation of maize-tempeh mixes as an instant food", the results of analysis carried out showed that the mixes have the potential of being incorporated into the Nigeria diets (Otunola et al 1998). In this study on tempeh, soybean was processed into tempeh (a fermented soybean product made by inoculating with *Rhizopus oligosporus*, consumed in Indonesia), maize was pre-gelatinized and the mix was

evaluated for proximate and nutrient composition, physico-chemical properties and microbiological quality. Protein, fat, carbohydrates, moisture, ash content of the products were 22.30 -22.80%, 12.10-12.16%, 58.96-60.23%, 1.93-2.24% respectively. The products contained significant amounts of B vitamins, Calcium, Iron and phosphorus. Amylogram pasting viscosities showed that the products could be classified as instant (precooked). Reconstitution index, bulk density, water absorption were 40mls, 0.52g/ml and 120% respectively. The total viable counts were very low in the range  $3.1-3.5 \times 10^3$  cfu/g. Sensory evaluation data indicated that the products were acceptable, this indicates the potentials of incorporating tempeh into the Nigerian diets as breakfast cereal (Otunola et al 1998). Tempeh is consumed in Indonesia, a developing country like Nigeria, although based in Asia. Tempeh is made from soya which is also available in Nigeria. In this study on tempeh, nutritional analysis was carried out but no reference was made to nutritional intervention or guidelines.

A study was carried out based on the increase in Protein-Energy Malnutrition (PEM) among children in developing countries. In this study on PEM among children, it was identified that traditional diets have low nutrient density and therefore the study aimed at determining the protein quality of complementary food using Bambara groundnut and cooking banana fruits (Ijarotimi and Olopade 2009). Bambara groundnut (BG) seeds and cooking bananas (CB) are available in village and urban markets in Nigeria; they were processed into flours using standard procedures and mixed in the ratio 60: 40 (CBR2) and 70: 30 (CBR1) of CB to BG respectively. Two control samples were used in this study, the traditional weaning food, *ogi* (corn gruel) and a commercial weaning food, Nutrend. The food samples were analysed for protein quality and amino acid content. Cysteine (CBR1 = 0.252g/100g; CBR2 = 0.336g/100g) was the lowest

amino acid determined while glutamic acid (CBR1 = 4.353 g/100g, CBR2 = 5.804g/100g) was the highest amino acid determined. There was an increase in amino acids with an increase in the percentage of Bambara groundnut. The amino acids for CBR1 and CBR2 were 31.8% and 42.4% respectively, the values met the recommended daily allowance (RDA) for essential amino acids. The biological value (BV) was 52.4% for *ogi*, 75.9% for CBR1, 90.5% for CBR2 and 93.8% for Nutrend which was not significantly different from the value obtained for CBR2. The total digestibility (TD), protein efficiency ratio (PER), net protein utilisation (NPU), feed efficiency ratio (FER) and nitrogen retention (NR) of CBR2 were in approximately the same range as Nutrend. The animals fed with the CBR2 food sample had a higher weight gain compared to those fed with CBR1 and *ogi*; but lower weight gain compared to those fed with Nutrend and casein. This study was able to establish the fact that a mixture of CB and BG 60: 40 can be used as a substitute for commercial weaning food and can help ameliorate Protein-energy malnutrition among children in developing countries (Ijarotimi and Olopade 2009). This study on PEM among children in the developing countries unlike the study carried out on Tempeh (Otunola et al 1998) and beta carotene content of commonly consumed foods and soups in Nigeria (Sanusi and Adebisi 2009), is focused mainly on children and did not consider adults' diets as most often children are given the same food consumed by the adults after the weaning stage which rarely exceeds two years after birth.

The risk factors for cardiovascular disease and diet of urban dwellers in Northern Nigeria, the Fulanis in particular showed that urban male Fulani dwellers consume more calories than rural male Fulani dwellers (ratio 2061 to 1691 kcal) while the women consume less, ratio 1833 to 1505 kcal urban to rural dwellers. These data (calorie intake) were obtained from analysis carried

out on nutrient content of the diets of 55 men (age 20-75 years) and 77 women (20 to 70 years) who dwell in urban centre in the North, the data collected were compared with data collected from a previous study on some rural Fulani dwellers (Glew et al 2004). Urban males and females had higher carbohydrate intake than the rural pastoralist, 51% to 38% female and 56% to 33% male; however, they had a significantly lower intake of dietary saturated and total fat compared to rural dweller, female 40% versus 51%, male 36% versus 51%. The exception was the HDL-cholesterol level which was higher in urban dwellers compared to rural dwellers, blood lipids in rural populations were also lower than that of urban populations; however, both rural and urban dwellers had homocysteine levels higher than the upper limit for healthy adults, the levels were 15.2 micromol/L for rural males and 12.7 micromol/L for urban males. It was concluded that the high levels of serum homocysteine are a cause for concern even though the lipids profile were low (Glew et al 2004). This study focused on only cardiovascular disease in relation to diets but other diseases were not considered.

The protein and vitamin B6 contents of foods commonly consumed in Nigeria by adolescents were determined over a seven (7) day period. The daily mean protein and vitamin B6 intake were  $62.1 \pm 13.1$ g and  $1.5 \pm 0.34$ mg respectively (Ajayi and Korede 1991). It was concluded that the groups who consumed staple diets based on roots and tubers or those who do not get their nutrient needs for protein will probably have poor Vitamin B6 statuses based on the results of chemical assays ( $r = 0.3927$ ,  $P < 0.02$ ) or microbiology assays ( $r = 0.7161$ ,  $P < 0.002$ ) which showed that there is a strong correlation between protein and vitamin B content (Ajayi and Korede 1991).

## CONCLUSION

There are various types of malnutrition prevalent in developing countries such as Nigeria which are Iron deficiency anaemia (ID/A), Protein & Energy Malnutrition (PEM), Vitamin A deficiency (VAD) and Iodine Deficiency Disorder (IDD).

The Federal Government of Nigeria came up with dietary diversification as a long term measure in combating these various types of malnutrition.

Report of current literature review on Nigeria diets showed that there are still gaps in knowledge as regard nutritional values, nutritional guidelines and intervention of cultural diets, in Nigeria.

Various studies were carried out on Nigeria cultural diets such as the determination of protein content of *ogi* (made with maize and sorghum), cassava starch and bread fruit (Adewusi et al 1991), prophylactic and therapeutic properties of *ogi* with the aim of proffering nutritional intervention to *Salmonella typhi* infection (Aderiye and David 2013), study of children consuming cassava in relation to Vitamin A, Zinc and Iron intake (Gegios et al 2010), cassava as the main cause of tropical neuropathy in Nigeria (Osuntokun 1980), consumption of cassava linked with increase in tropic ataxic neuropathy (TAN) in Western Nigeria (Oluwole et al 2000), consumption of poorly supplemented *garri*-based kwashiorkorigenic diet resulting in compromised renal functioning (Olasore and Samuel 2010), leafy vegetables as sources of Iron, Zinc and Calcium (Smith 1982), significant loss of ascorbic acid in vegetables to cooking water (Onyeike et al 2003) and Bambara groundnut and cooking bananas as substitute for commercial weaning food (Ijarotimi and Olopade 2009).

A study similar to dietary diversification was proposed in 2007 (Akinyele 2007), samples were collected from markets in all the geographical and regional zones in Nigeria with the aim of reviewing the present food composition table; there is however limited financial support to accomplish this study (Akinyele 2007).

Based on the literatures reviewed, it was observed that none of these studies addressed dietary diversification that is based on daily diets. There is also gap in knowledge as regard nutritional values, nutritional guidelines and intervention of cultural diets, in Nigeria. These areas need improvement and further research.

**REFERENCES**

- Aderiye, B. I. and David, O. M. (2013) Evaluation of prophylactic and therapeutic properties of *ogi* in rabbits infected with *Salmonella typhi*. *International Food Research Journal* **20**(1): 87-91.
- Available from:  
[http://www.ifrj.upm.edu.my/20%20\(01\)%202013/12%20IFRJ%2020%20\(01\)%202013%20David%20\(012\).pdf](http://www.ifrj.upm.edu.my/20%20(01)%202013/12%20IFRJ%2020%20(01)%202013%20David%20(012).pdf) (accessed 19 January 2013).
- Adewusi, S.R., Ojumu, T.V and Falade, O.S (1999) The effect of processing on total organic acids content and mineral availability of simulated cassava-vegetable diets. *Plant Foods Human Nutrition* **53** (4):367-380. Available from: <http://lib.bioinfo.pl/pmid:10540989> (accessed 19 January 2013).
- Adewusi, S.R.A., Orisadare, B.O. and Oke, O.L (1991) Studies on weaning diets in Nigeria. I. Carbohydrates sources. *Cereal Chemistry* **68** (2): 165-169.
- [http://www.aaccnet.org/publications/cc/backissues/1991/Documents/68\\_165.pdf](http://www.aaccnet.org/publications/cc/backissues/1991/Documents/68_165.pdf) (accessed 19 January 2013).
- Ajayi, O.A and Korede, O (1991) Protein and vitamin B6 content of foods consumed by Nigerian adolescents. *Food Chemistry* **36** (2): 229-235. Available from:  
<http://europepmc.org/abstract/AGR/FNI91002075> (accessed 3 February 2013).
- Akinyele I (2007) Upgrading Nigeria's food composition database with under-Utilized Nigerian traditional foods and recipes. A paper presented at the 31<sup>st</sup> National Nutrient Databank Conference, Washington DC. pp 3. Available from:  
[http://www.nutrientdataconf.org/PastConf/NDBC31/2-3\\_Akinyele.pdf](http://www.nutrientdataconf.org/PastConf/NDBC31/2-3_Akinyele.pdf).



Culture of Nigeria (2013 Available from: <http://www.everyculture.com/Ma-Ni/Nigeria.html> (accessed 13 June 2013).

De Onis, M. and Blossner, M. (2000) Prevalence and trends of overweight among preschool children in developing countries. *American Journal of Clinical Nutrition*, **72**:1032-1039. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/11010948> (accessed 13 June 2013).

Food and Agriculture Organisation of the United Nations/World Health Organisation 1992e, *Corporate Document Repository*. Available from: [http://www.fao.org/docrep/w0078e/w0078e09.htm#P7678\\_514896](http://www.fao.org/docrep/w0078e/w0078e09.htm#P7678_514896) (accessed 24 July 2013).

Gegios, A., Amthor, R., Maziya-Dixon, B., Egesi, C., Mallowa, S., Nungo, R., Gichuki, S., Mbanaso, A. and Manary, M.J (2010) Children consuming cassava as a staple food are at risk for inadequate zinc, iron, and vitamin A intake. *Plant Foods Human Nutrition* **65** (1): 64-70. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/20165984> (accessed 26 January 2013).

Glew, R.H., Conn, C.A., Vanderjagt, T.A., Calvin, C.D., Obadofin, M.O., Crossey, M. and Vanderjagt, D.J (2004) Risk factors for cardiovascular disease and diet of urban and rural dwellers in northern Nigeria. *Journal of Health Population Nutrition* **22** (4): 357-369. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/15663169> (accessed 2 February 2013).

Idah, P.A., Ajisegiri, E.S.A. and Yisa, M.G. 2007 Fruits and vegetables handling and transportation in Nigeria. *Assumption University Journal of Technology (AU J.T.)*. **10** (3): 175-183. Available from: [http://www.journal.au.edu/au\\_techno/2007/jan07/vol10no3\\_article6.pdf](http://www.journal.au.edu/au_techno/2007/jan07/vol10no3_article6.pdf) (accessed 22 September 2012).

Ijarotimi, O.S and Olopade, A.J (2009) Determination of amino acid content and protein quality of complementary food produced from locally available food materials in Ondo State, Nigeria.

Malaysia Journal of Nutrition 15 (1) : 87-95. Available from:

<http://www.ncbi.nlm.nih.gov/pubmed/22691808> (accessed 28 January 2013).

Inter Islam 1998-2001, òDiet in Islamö. Available from: <http://www.inter-islam.org/Lifestyle/diet.htm> (accessed 26 May 2012).

John, G.C., Nduati, R.W. Mbori-Ngacha, D. Overbaugh, J., , Welch, M., Richardson, B.A., Ndinya-Achola, J., Bwayo, J. ,Krieger, J., Onyango, F., and Kreiss, J.K. (1997) Genital shedding of human immunodeficiency virus type 1 DNA during pregnancy: Association with immunosuppression abnormal cervical or vaginal discharge, and severe vitamin A deficiency. *Journal of Infectious Diseases* **175** (1): 57-62. Available from:

<http://www.ncbi.nlm.nih.gov/pubmed/8985196> (accessed 13 June 2013).

Loevinsohn, M., and S.R. Gillespie (2003) HIV/AIDS, Food security and rural livelihoods:

Understanding and responding. *Food Consumption and Nutrition Division Discussion Paper* 157. Available from:

<http://www.ifpri.org/sites/default/files/pubs/divs/fcnd/dp/papers/fcndp157.pdf> (accessed 13 June 2013).

National Agency for Food and Drug Administration and Control (NAFDAC) 2006 Report on the GAIN Fact finding mission by the Director General of NAFDAC on 26<sup>th</sup> April 2006.

National Agency for Food and Drug Administration and Control (NAFDAC) 2010 Article on Nigeria-

Global Alliance for Improved Nutrition (GAIN) Project. Available from:

[http://www.nafdac.gov.ng/index.php?option=com\\_content&view=article&id=103:nigeria-global-a..](http://www.nafdac.gov.ng/index.php?option=com_content&view=article&id=103:nigeria-global-a..) (accessed 12 October 2013).

Nigerian Compass March, 2010, *Report on the Nigeria-GAIN project with NAFDAC. Hidden hunger and challenge of food fortification*. Available from:

[http://www.compassnewspaper.com/NG/index.php?option=com\\_content&view=article&id=44937:hidden-hunger-and-challenge-of-food-fortification&catid=43:news&Itemid=799](http://www.compassnewspaper.com/NG/index.php?option=com_content&view=article&id=44937:hidden-hunger-and-challenge-of-food-fortification&catid=43:news&Itemid=799) (accessed 17 June, 2010).

Nigeria's regions and their increasing agenda, *Nigeria Punch* (March 2012). Available from:

<http://www.punchng.com/politics/nigerias-regions-and-their-increasing-agenda/> (accessed 29 August 2012).

Oguntona, E.B and Akinyele, I.O (1995) Nutrient composition of commonly eaten foods in Nigeria-raw, processed and prepared. *Food Basket Foundation Publication Series*.

Olasore, A.H and Samuel, T.A (2010) Gari based kwashiorkorogenic diets compromised some renal functions in albino rats. *Asian Journal of Clinical Nutrition* **2** (4): 215-220. Available from:

<http://docsdrive.com/pdfs/ansinet/ajcn/2010/215-220.pdf> (accessed 23 January 2010).

Oluwole, O., Onabolu, A., Link, H and Rosling, H (2000) Persistence of tropical ataxic neuropathy in a Nigerian community. *Journal Neurosurg Psychiatry* **69** (1): 96-101. Available from:

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1736992/> (accessed 21 January 2013).

Onimawo I. (2010b), Reports on the 21<sup>st</sup> anniversary of the Food Basket Foundation International Initiative on repositioning nutrition for national development in Nigeria, *Joint University of Ibadan and Food Basket Foundation International Initiative Programme*. Available from: <http://allafrica.com/stories/201003240620.html> (accessed 22 September 2012) and also <http://maternalmortalitydaily.wordpress.com/2010/03/26/malnutrition-nigeria-maternal-child-infantmortality/>. (Accessed 22 September 2012).

Onyeike, E.N., Ihugba, A.C. and George, C (2003) Influence of heat processing on the nutrient composition of vegetable leaves consumed in Nigeria. *Plant Foods for Human Nutrition* **58** (3): 1-11. Available from: <http://link.springer.com/article/10.1023%2FB%3AQUAL.0000040327.57587.db?LI=true> (accessed 2 February 2013).

Osho, S.M., (1994) Methods for the dissemination of food processing technologies: the soybean example in Nigeria. *ISHS Acta Horticulturae* 375. Available from: [http://www.actahort.org/books/375/375\\_39.htm](http://www.actahort.org/books/375/375_39.htm) (accessed 30 July 2013).

Osuntokun, B.O., (1980) Cassava diet, chronic cyanide intoxication and neuropathy in Nigerian Africans. *World Review of Nutrition and Dietetics* **36**, 141-173. Available from: <http://www.cabdirect.org/abstracts/19811422049.html;jsessionid=E111DA1F726AE7F491C617B69DF4469B?gitCommit=4.13.20-5-ga6ad01a> (accesses 21 January 2013).

Otunola, E.T., Apoeso, O. and Adeyemi, I.A (1998) Development and evaluation of maize-tempeh mixes as an instant food product. *Bioscience Research Communications* **10** (4): 311-316.

Pelletier, D.L., Frongillio, E.A., Schroeder D.G. Jr. and Habicht, J.P. (1994) A methodology for estimating the contribution of malnutrition to child mortality in developing countries. *Journal of Nutrition* **124**:21065-21225. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/7931718> (accessed 13 June 2013).

Sanusi, R.A. and Adebisi, A.E (2009) Beta carotene content of commonly consumed foods and soups in Nigeria. *Pakistan Journal of Nutrition* **8** (9): 1512- 1516. Available from: <http://www.pjbs.org/pjnonline/fin1446.pdf> (accessed 23 January 2013).

Semba, R.D. and Neville, M. (1999) Breast feeding, mastitis, and HIV transmission: Nutritional implications. *Nutrition Reviews* **5**, **1**: 146-153. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/10391017> (accessed 13 June 2013).

Smith I.F. (1982) Leafy vegetables as sources of minerals in Southern Nigerian diets. *Nutrition Reports International* **26**(4): 679-688. <http://agris.fao.org/agris-search/search/display.do?f=1984/US/US84029.xml;US8203864> (accessed 19 January 2013).

The Nigerian Voice, 2012, Report on, ÷Vitamin A fortification: Nigeria scored over 80 per cent-NAFDACö. Available from <http://www.thenigerianvoice.com/nvnews/86663/1/vitamin-a-fortification-nigeria-scores-over-80-per.html> (accessed 12 October, 2013).

Tomkins, A., and Watson, F. (1989) Malnutrition and infection. *Geneva: ACC/SCN State-of-the-Art Series, Nutrition Policy Discussion Paper 5*. Available from: [http://www.unscn.org/layout/modules/resources/files/Policy\\_paper\\_No\\_5.pdf](http://www.unscn.org/layout/modules/resources/files/Policy_paper_No_5.pdf) (accessed 13 June 2013).

World Health Organization 1999, "Progress towards the elimination of Iodine deficiency disorders

(IDD)", (Document WHO/NHD/99.4), pp 5-20.. Available from:

[http://whqlibdoc.who.int/hq/1999/WHO\\_NHD\\_99.4.pdf](http://whqlibdoc.who.int/hq/1999/WHO_NHD_99.4.pdf) and

[http://www.who.int/nutrition/publications/micronutrients/iodine\\_deficiency/WHO\\_NHD\\_99.4/en/index.html](http://www.who.int/nutrition/publications/micronutrients/iodine_deficiency/WHO_NHD_99.4/en/index.html) (accessed 29 May 2012).

World Health Organization 2000a, *Obesity: preventing and managing the global epidemic*, WHO

*Technical Report Series 894*. Available from: [http://whqlibdoc.who.int/trs/WHO\\_TRS\\_894.pdf](http://whqlibdoc.who.int/trs/WHO_TRS_894.pdf)

(accessed 1 September 2012).

World Health Organization 2000b, *Turning the tide of malnutrition: responding to the challenge of 21<sup>st</sup>*

*Century*. (Document WHO/NHD/00.7 pp 3-11). Available from:

<http://www.who.int/mip2001/files/2232/NHDbrochure.pdf> (accessed 1 September 2012).

World Health Organization 2001, "Iron deficiency anaemia assessment, prevention and control: a guide

for programme managers". WHO/NHD/01.3 Available from:

[http://www.who.int/nutrition/publications/micronutrients/anaemia\\_iron\\_deficiency/WHO\\_NHD\\_01.3/en/index.html](http://www.who.int/nutrition/publications/micronutrients/anaemia_iron_deficiency/WHO_NHD_01.3/en/index.html) and [http://whqlibdoc.who.int/hq/2001/WHO\\_NHD\\_01.3.pdf](http://whqlibdoc.who.int/hq/2001/WHO_NHD_01.3.pdf) (accessed 29

May 2012).

World Health Organization 2002a, "Childhood nutrition and progress in implementing the International

Code of marketing of Breast-milk Substitutes", report from the secretariat. pp 1-6. Available

from: [http://apps.who.int/gb/archive/pdf\\_files/WHA55/ea5514.pdf](http://apps.who.int/gb/archive/pdf_files/WHA55/ea5514.pdf) (accessed 29 May 2012).

World Health Organization 2002b, "Physical inactivity a leading cause of disease and disability, warns WHO". Available from: <http://www.who.int/mediacentre/news/releases/release23/en/index.html> (accesses 28 February 2013).

World Health Organization 2003, "Diet, Nutrition and the Prevention of Chronic diseases", *Joint WHO /FAO Expert Consultation*. pp 11-45. Available from: [http://whqlibdoc.who.int/trs/who\\_trs\\_916.pdf](http://whqlibdoc.who.int/trs/who_trs_916.pdf) (accessed 13 June 2013).

World Health Organization 2004, *Severe malnutrition: Report of a consultation to review current literature 6-7 September 2004*. Available from: [http://www.who.int/nutrition/publications/severemalnutrition/Lit\\_review\\_report.pdf](http://www.who.int/nutrition/publications/severemalnutrition/Lit_review_report.pdf) (accessed 1 September 2012).

World Health Organization 2010, *Landscape Analysis on Readiness to Act in Nutrition –Executive Summary*. pp 1-3. Available from: [http://www.who.int/nutrition/topics/Executive\\_summary\\_LA.pdf](http://www.who.int/nutrition/topics/Executive_summary_LA.pdf) (accessed 16 June 2010).

**Table 1 Few diets in the three regional areas of interest**

South West-Yorubas	South East-Igbos	North West-Hausa/Fulani
<p>Staple food-</p> <ul style="list-style-type: none"> <li>• Yam</li> <li>• Yam by products such as <i>elubo</i>.</li> <li>• Cassava by products such as <i>garri</i>, <i>fufu</i> and <i>lafun</i>.</li> </ul>	<p>Staple food-</p> <ul style="list-style-type: none"> <li>• Yam</li> <li>• Cassava as Africa salad</li> <li>• Cassava by products such as <i>garri</i> and <i>akpu</i> (called <i>fufu</i> by Yorubas)</li> </ul>	<p>Staple food-</p> <ul style="list-style-type: none"> <li>• Maize</li> <li>• Maize by product such as <i>tuwo masara</i></li> <li>• Sorghum</li> <li>• Rice</li> <li>• Rice by product such as <i>tuwo shinkafa</i></li> <li>• Millet</li> </ul>
<p>Few vegetable stew-</p> <ul style="list-style-type: none"> <li>• <i>Efo riro</i> (<i>efo</i> is made with spinach or Amaranth)</li> <li>• <i>Efo elegunsi</i></li> <li>• <i>Orunla</i> (sun dried okra)</li> </ul>	<p>Few vegetables stew-</p> <ul style="list-style-type: none"> <li>• <i>Ugu</i></li> <li>• <i>Ukazi</i></li> <li>• Okra</li> </ul>	<p>Few vegetables stew-</p> <ul style="list-style-type: none"> <li>• <i>Kubewa</i> (sun dried okra)</li> <li>• <i>Kuka</i> (sun dried baobab leaves)</li> <li>• <i>Taushe</i> (Spinach)</li> </ul>
<p>Stew-</p> <ul style="list-style-type: none"> <li>• <i>Egunsi</i></li> <li>• <i>Obe eja</i></li> </ul>	<p>Stew-</p> <ul style="list-style-type: none"> <li>• <i>Banga</i></li> <li>• <i>White stew</i> (from</li> </ul>	<p>Stew-</p> <ul style="list-style-type: none"> <li>• Tomatoes</li> </ul>



• <i>Gbegiri</i>	<i>yam</i> )	
Ceremonial occasions- • <i>Obi</i> (kolanut)	Ceremonial occasions- • <i>Igba</i>	Ceremonial occasions- • Kolanut
Common morning meal- • <i>Ogi</i> with <i>akara</i> / <i>moinmoin</i> /sugar	Common morning meal- • <i>Akamu</i> (called <i>ogi</i> by Yorubas) / <i>akara</i> /sugar • <i>Akpu/garri</i> with vegetable stew	Common morning meal- • <i>Koko</i> (called <i>ogi</i> by Yorubas) with <i>kose</i> (called <i>akara</i> by Yorubas) / <i>alala</i> (called <i>moinmoin</i> by Yorubas)/ <i>shukar</i> (sugar)

Table 2 Medium óterm measure implemented by FGN

Food product	Micronutrients added	Level
Wheat	Ferrous orthophosphate/ Ferrous pyrophosphate	41mg/kg
White sugar	Iron  Vitamin A	700mg/kg  25,000 IU/kg
Vegetable oil	Vitamin A using transretinyl palmate at 20,000 IU	20,000 IU/kg
Salt	Iodine using potassium iodate	50mg/kg

**Table 3 Six Geographical Zones in Nigeria and the states in the zones**

<b>Geographical Zones</b>	<b>States</b>
North West	Sokoto, Katsina, Zamfara, Kebbi, Kano, Kaduna and Jigawa.
North East	Bauchi, Yobe, Borno, Gombe, Taraba and Adamawa
North Central	Kogi, Nasarawa, Benue, Niger, Federal Capital Territory (FCT), Kwara and Plateau
South West	Ogun, Ondo, Oyo, Osun, Ekiti and Lagos
South East	Enugu, Imo, Ebonyi, Anambra and Abia.
South South	Delta, Edo, Bayelsa, Rivers, Akwa Ibom, Cross Rivers

**Table 4 Three agro-ecological zones in Nigeria**

Agro-ecological zones	States
Dry savannah zones	Northern states (Sokoto, Zamfara, Katsina, Kano, Jigawa, Bauchi, Yobe, Borno, Kebi, Niger, Bauchi, Gombe, Adamawa, Taraba, and Plateau; some parts of Plateau and Bauchi are moist mid Atlantic)
Humid forest zones	Southern states (Bayelsa, Rivers, Akwa Ibom, Delta, Imo, Abia, Cross River, Lagos and some part of Ogun, Ondo, Edo and Anambra,)
Moist savannah zones	Ogun, Oyo, Kwara, Osun, Ekiti, Kogi, Benue, some parts of Taraba, Nasarawa and Abuja