



Potentials of Nigerian Indigenous Food Products for Addressing Nutritional Needs of Persons in Internally Displaced Persons' Camps (I. D. P. Camps)

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Abstract

This review covers various facets of Nigerian indigenous food potentials, particularly for addressing nutritional needs of persons in Internally Displaced Persons' Camps (I. D. P. Camps). These Nigerian indigenous foods includes: Beverages, milk and milk products/agunts, porridges, condiments or fermented spices, pastries, fried foods, steam-cooked foods, smoked fish and meat, roasted meat and also oils. The paper also focuses on description of indigenous foods and processing, their composition on major nutritional needs; and also their nutritional potentials and health benefits. Other areas are recent advances in research on indigenous foods, businesses and companies involved in their production. The introduction of some indigenous food into Daily Menu of National Nutritional Guideline for Prevention, Control and Management of Non-Communicable Diseases were documented for use. Recent advances on good technology for processing, packaging and preservation were viewed. Varieties of indigenous foods with potentials were observed but lack good technology for processing.

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Introduction

Nigeria is a country endowed with great diversity of tribes, languages [1], and foods of various kinds [2]. Indeed, Nigeria diversity in foods may not be different from the evidence that traditions, beliefs and values were among the main factors influencing mode of food preparation, preference, serving, nutritional needs and food categories [3, 4]. Divers groups and varieties of Nigerian indigenous foods were reported by many researchers [2, 5]. Within a single tribe, it is easy to have differences in mode of food production and habits [3]. Example, within a set of the food called *Kunu* (nonalcoholic drink) there are diverse subsets of *Kunu*. Gaff et al [6] and Solange et al [7] reported categories of cereal beverages. Example, each of these either *Kunun gyada* or *Kunun zaki*, there are diverse varieties. The mode of preparation of one type of *Kunu* may differ significantly from one place to another; the name and the final product may also vary with varying potentials. Similarly, another variety may result from the uses of different raw material. Ayo-lawal et al [8] reported that melon seeds, fluted pumpkin and castor oil seeds is being used to create different varieties of condiments of *Ogiri* such as *Ogiri-egusi*, *Ogiri-ugu*, *Ogiri-isi* and *Ogiri-okepiye*. Besides these, there are general common foods that are either consumed or seen by at least half of the population of Nigerian such as *Eba* or *Tuwu*. The country is also blessed with divers' cultivated crop plants [9] and animals. Its wild forest is also teaming with nutritious tropical plants [10] and animals. However, Nigerian refugees are not enjoying these potentials.

Indigenous foods in Nigeria have an important role in the life of people. [5] Reported that in Nigeria, the traditional foods with potentials are available and are many and communities have evolved their own preferences and food habits overtime and will rather stick to what is familiar. According to [3], the term food is an aspect of cultural tradition. It plays an inextricable role in human lives. It is a source for pleasure, comfort and security; also a symbol of hospitality, a means for social status and religious values. What we select to eat, how we prepare it, serve it, and even how we eat it are all factors that touches our individual cultural inheritance or life. Food plays a vital role in our daily lives because without food we cannot survive. However, Nigerian refugees are not enjoying these comforts and securities.

Indigenous foods in Nigeria did not just come at a glance among its producers, but as a form of extensive formulations using trial and error. What is bad is totally rejected and thrown away. Example, *Burukutu* (indigenous low alcohol beverage) alone was said to have been conceived overtime. Later it was concocted deliberately to kill stepchildren by a stepmother. But unfortunately for her the children drank-slept and woke-up were asking for more supply. Surprisingly, the processor joins in sipping to her taste. Today, it is known to be a food with good potentials Fadahunsi *et al* [7] and Solange et al [11] reported that this drink has both nutritional and health benefits, and it is being used extensively in many traditional festivals and ceremonies. For these reasons, this drink and other fermented nonalcoholic drinks (e.g. *Kunun tsiro*) can be used as an alternative for interventions to minimize harmful use of alcohol and other psychoactive substances (drugs, opioms, heroin, cocaine, cannabis, high alcoholic drinks) in refugees' camps. Similarly, a dimension of refugees' counseling for gradual withdrawal or from the increased risk of substance misuses, since it was reported that high percentage of refugees worldwide abuse substances

because of their sorrows [12, 13]. While these foods have those targets, other indigenous foods can also be used in solving diet related problems, such as in combating hunger and starvation, malnutrition and non-communicable diseases. There are also many of these foods with the potentials of improving the human defense mechanisms, which would be good for vulnerable refugees.

In fact, Nigerian indigenous foods have great nutritional and therapeutic potentials that one cannot just ignore. The advantages of using Nigerian indigenous foods for humanitarian interventions are many. Acceptability of strange food within a short period may not be straight forward, but over time. Consumption of strange diet may affect individual preference and at the same time deprive one of good nutrition [4, 14]. Those consuming indigenous foods have minor issues about the fear of the unknown. Genetically Modified Food, which is mostly considered throughout the world as foreign products (strange) have potential problems; such as alteration in nutritional quality, source of potential toxins and allergic substances. Others, which are of major concerns, are religious, cultural and ethical issues [15, 16]. Today, many Nigerian elders believe that one of the causes of high deaths rate among young Nigerian, may not be far fetch from the consumption of some of the modern diet. Humanitarian interventions with indigenous foods are prompt and affordable compared with those shipped from abroad. These foods are also cheap and simple to be prepared. Secondly, history of those imported foods cannot actually be ascertained, especially their raw material sources and even the technology used for their production. Alteration, adulteration, misbranding etc. are often reported of such foods by the regulatory agencies. Another advantage of using indigenous food is that, many food crops grown in Nigeria, uses limited chemicals and sometimes no available chemical fertilizer to be applied on farms except manure.

On this basis, the objective and overview of this paper is to examine the potentials of Nigerian indigenous foods, based on their compositions, nutritional and health benefits for ensuring the nutrition security of individuals in Internally Displaced Persons' Camps (I. D. P. camps).

Materials and methods

The information used for this study were obtained from scientific publications, Hausa-English dictionary translation and from women who are into the business of indigenous food production. Many indigenous foods which were not included in this study were either the food is fully not Nigerian based; has limited potentials or did not cover well in the geopolitical zones of Nigeria.

Results and discussion

Description of products, their nutritional and health potentials

Nigerian nonalcoholic beverages

Kunun zaki also known as *Danyan damu*, it is the type of beverage that the production process receives mild heat or used warm water for extraction of wort. It is because of its sweetness that the product is often called *Kunun zaki*. Solange et al [7] reported that it is likely that traditionally fermented drinks have an important role in preventing acute diarrhoea because *Koko sour wort* could help reducing persistent diarrhoea of young children; *Kunun-zaki* is also popularly believed to enhance lac-

tation in nursing mothers. Gaffa et al [6] reported that *Kunu zaki* have a protein content of 3.02 to 3.19 g.

Kunun tsiro is another type of beverage produced from mixtures of malt and unmalted cereals, it was said to have very sweet taste. *Kunun tsiro* is often being used to satisfy hunger and have sedative power. Other benefits include supply of energy and have healing ability of stomach discomfort. This product was reported by Gaffa et al [6] to have protein contents of 3.98 to 4.03 g.

Kunun aya is also one of the types of beverage with certain unique taste. It is sometimes called *Kunun zaki* by many Nigerian. However, once whether completely or there is proportion of tiger nut is added before, during, or after fermentation of the mixture, the specific name for the final product was said to be *Kunun aya*. Some tribes in the Northeastern part of Nigeria, who were said to have inherited the production technology from their ancestors, understood this confusion among Nigerians but let it go. It is often being used for refreshment, for entertainment of guest in ceremonies and social gatherings. It was said that it can be taken at any time of the day especially during hot weather to minimize body dehydration from the hot tropical condition.

Palm wine (unfermented type or sweet palm wine) is a palm sap; white liquid collects from palm trees, which tend to be very sweet and non-alcoholic. But naturally, when left without preservation, the palm sap begins fermenting immediately, due to the presence of natural yeasts in the air or contaminants in the collecting containers. It was reported that this sap is rich in vitamin A and soluble sugars.

Aoyo is another type of drink produced from ripe pineapple juice and supernatant derived from *Ogi*. It is a yellowish local drink and does not undergo fermentation. It is very rich in ascorbic acid, with about 32.0 mg/100 g of the juice [17] reported another form of beverage called *Omi wara* (water extract obtained from cheese). It is one of the local drinks in the Northern part of Nigeria; it was reported to be nutritious and serves the same advantage as liquid milk. Its vitamin C content is about 2.5 mg/100 g.

Sobo drink or *Zoborodo* (*Isapa* or *Aukan*) is an aqueous extracts (hot water extraction process similar to that of tea) of calyx of rosella. It is a nonalcoholic local beverage made from the reddish purple, acid-succulent calyces of the flower *Hibiscus Sadderiffa*. It was reported to be rich in vitamins, antioxidant and minerals [17]. It was reported to be rich in calcium, niacin, riboflavin and iron. It has great medicinal potentialities. It is being used for managing patients suffering from Type II Diabetes. More importantly, the hypoglycemic and hypolipidemic reduction effects by the calyces of Sorrel. Most people in Nigeria drink *Sobo* because of its unique potentials and good sensory appeals [18].

Nigerian alcoholic beverages

Burukutu and *Pito* are produced from cereals. The method of production differs slightly and products yields differ significantly with *Pito* having a distinct layer of separation into supernatant and infranatant. Their organoleptic profiles were said to differ significantly. These products are often taken by its consumers because they satisfy hunger. The nutritional value and organoleptic taste of these products enhances acceptability among its consumers Fadahunsi et al [11]. Their nutritionally values comprises of iron, manganese, magnesium, phosphorus,

calcium and vitamins Kolawale et al [11], Fadahunsi et al [19]. Microbial associates are *Saccharomyces cerevisiae*, *Candida krusei*, *Torulopsis spp.*, *Lactobacillus brevis*, *Streptococcus spp.*, *Staphylococcus aureus*, *Pseudomonas fragilis* and *Aspergillus spp.*, *Mucor spp.*, *Rhizopus stolonifer*, *Escherichia coli*, *Bacillus subtilis* Kolawale et al [11], Fadahunsi et al [19]. The ash content of *Burukutu* were reported to range from 0.04 to 4.8 g, crude fiber 2.49 g, moisture 97.35 g, crude protein 3.10 to 5.80 g, carbohydrate 82.85 g, pH 3.48 to 3.90 and alcoholic content 1.70 to 2.80 g. For *Pito*, ash content is 0.001 to 4.00 g, crude fiber 1.05 g, moisture 96.56 g, crude protein 2.50 to 5.42 g, carbohydrate 80.16 g, pH 3.66 to 4.20 and alcoholic content 3.00 to 3.09 g. Lactic acid, sugars and amino acids are other components reported [11, 19, 20]. Their crude protein is comparable with that of yoghurt (Crude protein 2.02 to 3.49 g) as observed [21].

Palm wine (fermented) or toddy is other similar product, though from sap of various species of palm tree such as *Palmmyra* and coconut palm. It is commonly called *Emu* and *Oguro* in Western part of Nigeria. Alcoholic content this drink is reported to be about 3.1 g [17]. Among its consumers, they are being used as pain relievers, sedatives and for combating hunger. Small quantity is often administered to infant for relieving stomachache. Nigerian alcoholic beverage such as *Burukutu*, *Pito* and Palm wine is very low in alcoholic contents compared to conventional beer. Secondly, there were no cases or history of alcoholic intoxication being recorded on people consuming such drinks. Fadahunsi et al [7], and Solange et al [11] reported that during marriage ceremonies, festivals and funeral celebration, they are often served to sustain hunger and energy.

Nigerian milk and milk products/agunts

Nono is traditionally fermented milk. This *Nono* is sometime called *Kwasam* or *Chirum*. It is a completely skimmed or defatted *Kindirmo* (yoghurt) obtained through churning process Sudi et al [22]. *Nono* is prepared by inoculating fresh pasteurized cow milk with a little of the leftover starter culture and then is allowed to ferment for twenty-four hours at room temperature. At the end of the fermentation period, the milk butter is removed by churning for further use and the remaining sour milk (*Nono*) is a delicious and refreshing drink. *Nono* is an excellent source of protein, rich in essential amino acids and a good source of calcium, phosphorus and vitamin A, B, C, E and B complex. The type of microorganism associates with *Nono* and are believed to have health benefits include: *Lactobacilli* (*L. acidophilus* and *L. bulgaris*), *Lactococci species* (*L. cremoni*, and *L. lactis*), *Streptococcus thermophilus*, *Leuconostoc species* and *Saccharomyces species* Evans et al [20].

Kindirmo is traditional yoghurt. It is a fermented whole milk; sometimes the whole milk that was partially skimmed and fermented or completely fermented milk that was partially skimmed and Sudi et al [22]. It has similar health benefits attributed to yoghurts. The consumers of this product believe that it adds years to their lives Bristone et al [23]. It has similar microbial associates as that of *Nono*.

Nigerian imitation milk are many such as tiger nut milk (*Madaran aya*) which is one of the most widely consumed Nigerian vegetable milk after soybean milk (*Madaran waken suya*); Followed by cocoa nut milk extract (*Madaran koko*). Tiger nut milk is extracted from dry; dry toasted or wet tiger nut. It is extracted by crushing (milling) the nut, followed by reasonable addition of water to strain the slurry Bristone et al [23] its protein content ranged from 0.83 to 1.74 g Bristone et al [24]. Study

conducted by Wakil et al [25] did not differ significantly except for fat (0.76 to 3.0.2 g). Their microbial associates are *Bacillus subtilis*, *Bacillus cereus*, *Staphylococcus aureus*, *Rhizopus sp*, *Saccharomyces sp*, *Mucor sp* [26]. Some tribes in the North-eastern part of Nigeria who are much into tiger nut production and processing regards tiger nut milk and any other similar products as “water”. The word *Kunun aya* and tiger nut milk (*Madaran aya*) should not be confused if each of their benefits is to be derived. It was said that such “water” is being use to welcome strangers especially one that come from a far distance journey; to sustain lost energy. The consumers of tiger nut milk strongly believes that it help body to offer resistance against cold weather and scavenge rheumatism. In those days when there was no modern means of transportation, people consumed it in order to prepare them against foreseeing stress. The description given was analog with tonics in function. It was said that this type of drink (tiger nut milk) is often being used to give extra-ordinary strength (energy) to warriors, wrestlers, farmers, undertaker of ancient times, arduous journeys and that the benefits of this product can be derived only if it was prepared fresh and taken. Similar drinks was said to have been made from clay mode to blackmail the merchants Portuguese during the trans-Saharan slave trade. [27] Reported similar potential benefits of consuming tiger nut milk. It was found to be rich in essential minerals, unsaturated fats, vitamins and amino acids for healthy body functions. Good for lactose intolerance and for management of cardiovascular diseases.

Wara (Yoruba cheese) or *Cuku* (Fulani cheese) is a Nigerian native. It may be produced from milk as similar to conventional cheese or from soybeans paste after separation of the casein and whey and then fried. In other part of Nigeria, it is also called *Awara* or *Tofu* (soycheese). This cheese is believed to have same benefits as conventional cheese Ogundele et al [28] Ladies and children was said to have strong desire for it than any other group of public.

Dakkeri and *Furra* are well-known Nigerian milk adjuncts. *Fura* which is made from millet flour mixed with water and compressed into balls and cooked for about twenty to forty minutes, are used in combination for consuming Nigerian various milk drinks especially the fermented ones. The cooked *Fura* is crumbled in a bowl of *Nono*, which is called *Fura da nunu* Evans et al [20]. The *Dakkeri* is analogue to *Furra*. However, it is steam-cooked grist of cereal. The major aim of these mixes is to add to the degree of fullness of fermented milk drinks. Some people consumed it without mixing with milk.

Nigerian thick or stiff porridge

These types of food are often prepared from whole flour of either cereal or tuber. It is a starchy food that are cooked to a dense or stiff paste and eaten with various soups. In other parts of Nigeria, they are often called “swallows” simply because of the method of take in the mouth. *Tuwo*, which is one of those stiff porridges, it is a thick cereal food popularly consumed in the northern part of Nigeria.

Agidi or *Eko* is another stiff porridge prepared from fermented cereal paste. The proximate composition of flour of *Agidi* produced from maize was reported to be 6.75 g for moisture, 3.76 g protein, 7.67 g fat, 1.09 g fibre, 1.20 g ah and 79.65 g for its carbohydrates Akinola et al [29] *Amalla* is also another form of stiff porridge prepared from yam flour and is locally known as *Amala işu*. Those prepared from plantain is called *Plantain amalla*.

Pounded yam (*Iyan*) also known as *Iyan*, is prepared from boiled yam tuber; pounded using pestle and mortar to obtain stiff porridge.

Eba is another stiff porridge made from *Garri* (grated cassava paste that was fermented, dried and toasted). *Garri* can be either yellow or white in colour, which give resultant yellow or white colour of *Eba*. The yellow colour results from the addition of crude oil palm during toasting.

Fufu or *Foofoo* (also *Tapioka* or *Akpu*) is a fermented white paste made from cassava. It is ranked next to *Gari* as an indigenous food of most Nigerians in the South. *Fufu* is made by soaking whole or cut peeled cassava roots in water to ferment for maximum of three days. This is then turn in boiled water (cooked) to obtain a stiff porridge that can be consumed with soup Evans et al [20], Adebayo-Oyetoro et al [30], Okeke et al [31] reported composition of *Akpu* produced from fresh cassava and dried cassava flour as 53.30 g moisture, 1.40 g ash, 0.01 g fat, 0.60 g protein, 0.60 g fibre, 44.21 g carbohydrate and 54.85 g moisture, 0.68 g ash, 0.05 g fat, 0.27 g protein, 0.12 fibre and 44.01 g carbohydrate respectively.

Lafun is a fibrous powdery form of cassava similar to *Fufu* in Nigeria. The method of producing *Lafun* is different from that of *fufu* in the traditional preparation; fresh cassava roots are cut into chucks and steeped for 3-4 days or until the roots become soft. The fermented roots are peeled, broken up into small pieces and sun dried. The dried pieces are milled into flour. The flour is made into dough with boiling water before consumption. When properly stored, it has a shelf life of six months or more Evans et al [20].

All of them are carbohydrate rich foods and their carbohydrate contents are most often between the ranges of 40 to 80 g. They are usually consumed with soup for better nutritional benefits. Some of them that are fermented are known to improve stomach digestive system. These groups of food are the Nigerian outmost diet and are often used to satisfy hunger. A Nigerian man cannot survive well without introducing one of them into his Daily Food Menu.

Nigerian condiments (flavourings) or fermented spices

Dawadawa (*Iru*) is prepared using boiled and dehulled cotyledon of the seeds of African locust beans (*Parkia biglobosa*). Then, it is allowed un-inoculated for solid-state fermentation to take place naturally. Its protein and fat content are reasonably high (fat 39 to 40 g and protein 31 to 40 g). Consumption of this condiment was reported to maintain and improves good health condition of the heart. It may also prevent the development of myocardial infarction disease in human Evans et al [8], Ayo-lawal [20]. Microorganisms reported in this product are *Bacillus spp* and *Staphylococcus spp*. However, *Bacillus spp* was believed to be the major fermenting organism Ayo-lawal et al [8]. It was reported to be rich in calcium, iron and vitamins especially riboflavin. It was also reported that it has very good shelf life stability Uzogara et al [15]. Its flavour in soup always gives satisfaction even if without enhancing it with table salt.

Ogiri is another similar form of condiment. It is produced from the fermentation of oil seeds. The raw castor oil seed are boiled until the seed changes colour to brown. The seeds are dehulled, rinsed in clean water and re-boiled again. It is then cooled and wrapped with enough banana leaves, which is then packed in a clean container to ferment at room temperature Evans et al [20]. It is being used as nutritious non-meat protein

substitute. It plays a vital role as condiment and flavouring in soups and sauces. Different animal (rat) model study using *Ogiri* indicated beneficial effect in lowering the risk of coronary heart diseases. *Ogiri* comes in divers' forms and with their unique flavour characteristics. Microorganisms isolated from *Ogiri* include *Lactobacillus spp.*, *Bacillus spp.*, *Aerococcus viridance*, *Staphylococcus aureus*, *Micrococcus luteus*, *Aspergillus niger*, *Penicillium spp.* and *Fusarium eguseti* Ayo-lawal et al [8].

Afiyo as is called by the Hausas or *Okpehe* as called by Idomas people. It is a fermented condiment and most popular around the middle belt of Nigeria. It is produced from leguminous oil seed called *Prosopis Africana*. Fermentation is by moist solid state by many species of microorganisms. It is most often produced in parts of Benue, Niger, Kaduna states and northern parts of Kwara state. The product is unique because of its strong flavour impact Evans et al [20].

Dawadawa ugba, *Afiyo*, *Dangwua* are other forms, also with their unit flavour characteristics Evans et al [20]. Another one called Muzsha with unique characteristics flavour found among Kilba and Margi in the northeastern parts of Nigeria is said to be produced from oil seeds, potash extract and chunk of bones and meat. This mixture was said to be fermented in a closed pot and later dried. Apart from its flavouring characteristics, it was said that it gives its consumers ability to resist fracture during war or accident. It was also said, it gives human carcass resistance against decomposition in the grave; at the same time gives next generation impression of seeing the remains of their ancestral during burial of family members in same grave. Similar, another formulation from the seed of *Hibiscus Sadderiffa* was said to increase milk yield during lactation. More importantly, fresh extract from the seed.

Nigerian complementary foods

Ogi is produced generally by soaking any cereal grains in water for one to two days followed by wet milling and sieving through a screen mesh. The sieved material is allowed to sediment and decanted. It is called *pap*, *Akamu*, or *Koko*. *Sacharomyces cerevisiae*, *Enterobacter cloacae* and *Lactobacillus plantarum* have been found to predominate it Evans et al [20]. It has low protein content if it is not complemented with protein rich source. However, it posses good texture characteristics suitable for infants feeding Bristone et al [24].

Kunu (gruel type) is consumed anytime of the day by both adult and children as breakfast drink and food supplement. Many of these come in diverse colours, flavours and textures. Some may be smooth if made from fine flour; some rough especially those produced from grist or whole grain that was not milled into flour. It is a refreshing drink usually used to entertain visitors; used as appetizers and is commonly served at social gatherings. The name and the processing technology also vary from region to region Gaffa et al [6], Evans et al [20]. But if groundnut paste is not added during preparation, it is basically described as *Talge*. *Talge* prepared using Tamarind fruit pulp extract (*Tsamiya*) was said to be the first meal given to patient for resuscitation; loss of appetite due to one type of disease condition; and severe hunger due to fasting; before administering any nourishing meal. People that consume *Kunu(s)*, generally gain much health benefits.

Kunun gyada is one of the most important homes prepared complementary foods. It is also taken as breakfast cereal drink by all classes of children and adults. It is used extensively during

fasting periods, ceremonies, school feeding, and management of people with health problems. Mode of preparation may differ significant depending on its intended uses; which also help to create varieties of *Kunun gyada*. Nutritional composition of different blends of *Kunun gyada* reported by [32] ranged from 83 to 86 g for moisture, then for protein 2.2 to 2.7 g, fat 0.7 to 1.0 g and fibre 0.1 to 0.9 g [32]. In another study by [6] reported 3.45 to 3.98 g of protein in *Kunun gyada*.

Kunun aya (gruel type) is one of the types of thin porridge similar to *Kunun gyada* in preparation and function. It is prepared from the flours of either toasted or raw tiger nut. The tiger nut flour is constituted with water and is prepared by heating the mixture to boil as thin porridge. It is often being used as complementary food. The consumers of this product believe that *Kunun aya* gives them ability to withstand extremely cold condition in the rain when farming and inside cold river when fishing. Other benefit was also said to help in smoothening skin wrinkles usually caused by aging or fatigue. Similar benefit of consuming tiger nut and its products (such as tiger nut milk) was also reported by Nkama et al [27].

Kunun kangwa is usually made from flour of cereal grain with addition of small quantity of *Kanwa* (Trono ore i.e. purified sodium carbonate: $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$). It was said that, it is being given to people that had circumcision for fast healing of their wound. However, it was said that some people enjoy taken it for their breakfast because of its unique taste while others reject it completely.

Nigerian roasted, baked or stem cooked foods

Ubkwa or *Alale* (*Moi-moi* or *moin moin*) is usually prepared from cowpea paste place in polyethylene bag and tied, before stem cooking. It is also often taken as snack. It is another meat protein substitute and can fully satisfy hunger especially if prepared with good mixtures of spices and essential oil.

Okpa (From bambara groundnut) also called bambara fufu is analogue to *Moi-Moi*. It is also rich in protein and has good degree of satiety. It is most often being consumed as snack and for breakfast Okeke et al [31]

Guliguli is usually prepared using sorghum flour. Flour is constituted with water and sweetened with sugar to form stiff paste. It is then wrapped in leaves and steam cooked or roasted. Originally, the stiff paste, the leaves and the steam-heating effect was said to significantly impact some desirable organoleptic profiles especially texture and flavour. This product is often consumed as snack. One of its benefits was that is very simple to prepare Bristone et al [23].

Nigerian fried foods

Akara (fried bean cake) is one of the most popular local dishes in Nigeria. It is usually eaten as breakfast with *Ogi*, or lunch with *Gari* or even dinner with *Eko*. *Akara* is a traditional food made by deep frying cowpea paste (batter) that has been whipped and seasoning with salt, pepper, onions and other optional ingredients. The outer crust of *akara* is crisp and the interior is spongy like bread. It is considered to be the most commonly consumed cowpea based food in West Africa Ogundele et al [28], Ajibola and Filani [33]. The protein content of *Akara* was reported to ranged from 23.5 to 26.2 g; ash content ranged from 3.1 to 3.57 g; crude fibre ranged from 3.27 to 3.63 g; crude fat ranged from 23.21 to 26.14 g and carbohydrate ranged from 43.32 to 44.24 g (Ajibola and Filani, 2015). These results did not

vary much as reported by Akara by Ogundele et al [28].

Kulikuli or *kwilikwili* is a fried groundnut cake. It is produced from toasted groundnut which was milled into groundnut paste. The paste is prepared for separation by adding hot water intermittently to extract the oil from the cake. The cake is molded into desired shapes and fried using same extracted oil. The resulting cake is a good delicacy for drinking tea and other beverages. The cake can also be used as livestock feed. It can be further converted into spices such as *Yaji* Abdulrahman et al [34]. It is very rich in proteins and has good shelf life stability.

Masa is a fermented puff batter of cooked (fried) cereal food. The fermented puff batter is fried inside a pan with individual troughs like small cups containing vegetable oil Evans et al [20]. *Masa* is usually served as a breakfast cereal. It is also being used during fasting period, marriage ceremonies and other social gatherings. *Masa* is consumed in various forms by all age groups in the northern states of Nigeria [35].

Tsatsafa is normally made from cereal paste and sugar. The frying process was said to require the use of perforated spoon to allowed flow of paste through the holes which help to introduce air into paste and create spaces in the fried food. It is very sweet because the technology of its processing requires the use of much sugar and also for better crispy texture. In northern Nigeria, it is one of those brides made food for the groom. Another advantage is the food has good storage life stability.

Waina and *Pinkaso* are mostly made from cereal paste. But it can also be made from tuber paste, though *Waina* is often made from cassava paste. The frying process is similar to that of *Kuse* (Akara). These products were said that they are not made to keep for long time because of short storage life.

Dambu nama is a type of meat that was cooked, pounded, shredded, seasoned and fried. It is a meat often used as snacks. *Dambu nama* is also being used to served people in ceremonies. It has good storage stability. It is very rich in protein (37.14 to 45.86 g), fat (11.2 to 17.84%), ash (4.87 to 5.18 g) and mineral elements Eke, et al [36].

Nigerian flours and other related products

Gari (*Garin kwaki*) is granular flour with fermented flavour made from cassava. It has slightly sour taste. *Gari* is made by milling the cassava tuber into paste and fermented, followed by drying and toasting using either palm oil or any other vegetable oil. The palm oil usually produce yellow creamy colour of *Gari* while the other produce white creamy colour. It is commonly consumed either by being soaked in cold water with sugar, coconut, roasted groundnuts, dry fish, or boiled cowpea as complements or as a paste made with hot water and eaten with vegetable sauce Evans et al [20]. It is a convenient ready-to-eat food. It is easily prepared to conform to the organoleptic preference of the consumers Onu et al [37]. In Hausa land, the word *Kwaki* or *Kwage* is usually precede *Gari* to differentiate it from the conventional flour (i.e. *Gari*). Onu et al. [37] reported that its moisture content ranged from 4.6 to 10.15 g, ash 2.03 to 2.11 g, protein 6.24 to 8.40 g, fibre 3.51 to 4.04 g and fat 1.82 to 2.79 g. Evans et al [20] also reported that *Geotricum candidia* and *Corynebacteriumlactis* help in cyanogens detoxification in cassava during production of *Gari* and impact desired flavour. It is also being consumed without adding anything to it to help in arresting diarrhea.

Elubo is native flour made from cassava. It is being used for

preparing *Fufu*, *Lafun* or *Ako*. The method of its production varies from place to place but all with the aim of destroying cyanogenic glucosides in cassava roots Evans et al [20], Adebayo-Oyetoro et al [30], Okeke et al [31].

Upursah (*Mbursa*) is flour made from either raw or toasted tiger nut. A food consumed among Kilba, Margi and Bura in the northern part of Nigeria. It has many applications; it can be licked directly or used for the production of *Kunun aya* (similar to *Kunun zaki*), tiger nut milk (*Madaran aya*) and also *Kunun aya* or *Kunu* (the gruel type). Flour of tiger nut can also be complemented with other cereal flours [38]. Similar usage was reported by [27]. especially in confectionery and baking industries. It is also very rich in essential amino acids, minerals and vitamins. The concentration of these nutrients is expected to be more in tiger nut flour.

Dakuwa is a similar product to tiger nut flour. However, it is usually complemented with groundnut. The flours of both is pounded and molded into round shapes. It is very rich in essential oil and protein. It has similar usage as *Upursah* [38].

Nigerian smoked meat and fish

Banda is a smoke-dried meat or fish. The smoking process (method) varies from one place to another. The meat may be pre-cooked before smoking, kiln drying or sun-drying. The major aim of smoking meat or fish in Nigeria is mostly for preservation purpose. Though smoking was known to impact desirable flavour and so increases the acceptability of meat Evans et al [20]. Many people who often discriminate against fresh meat or fish often accept smoked meat or fish. Smoked fish today tend to be more available on Nigerian market than smoked meat.

Nigerian roasted meat

Tsire is a popular Nigerian stick meat commonly produced by grilling. It is a sliced beef meat that has been hanged on tips of sharpened sticks. It is a boneless meat product usually cooked around glowing charcoals. The sliced pieces of meat are staked on wood sticks, spiced with peanut cake, spices, vegetable oil, salt or other flavouring [39], Olaoye et al.[40]. This meat is said to be very important in nourishing the human body. It was also believed that it increases male fertility.

Kilishi is a tropical intermediate moisture meat product that is prepared essentially from beef slices, infused in slurry of de-fatted groundnut paste and spices and sundried. The product has the ability to keep for several months at room temperature. It has 10.00 g moisture, 60.33 g protein, 14.24 g fat, and 8.78 g ash [41]. It was said that *Kilishi* is very expensive, more than any type of meat sold in Nigeria. It is believed that its nutritional benefits cannot be compared with most type of meat products consumed in Nigeria.

Balangu is a common meat that was roasted or grilled. *Balangu* is not made to be stored for more than a day. It is good to be eaten immediately after processing. This group of meat if not stored properly are reported to be contaminated easily and spoiled by the following microorganisms: *Penicillium sp*, *Rhizopus sp*, *Cladosporium sp*, *Aspergillus sp*, *Mucor sp*, *Bacillus sp*, *Streptococcus sp*, *Staphylococcus sp*, *Escherichia coli*, *Proteus*, *Pseudomonas* and *Klebsiella* [39, 41].

Nigerian oils

Red palm oil is a Nigerian crude oil extracted from the fruit of palm tree. It was reported to contain high amount of vitamin

A. It has very good functional characteristics for the preparation of most Nigerian foods [5]. Its unique red colour help to mask some undesirable colours of foods.

Sheer butter oil is extracted from the kernels of sheer butter tree; it is also one of the Nigerian oil with much potential. The method of extraction and the intended usage varies from one community to another. Shea butter is being used for treating rheumatism, inflammation of the skin, nostrils, nasal congestion, leprosy, cough, and minor bone dislocation. It has also been used for soothing and accelerating healings after circumcision and for preventing stretch marks in African pregnant women, sheer butter itself can be used as great emollient and moisturizer. Shea nut contains 37 to 55 g of fats with significant amount of palmitic (16:0), stearic (18:0), oleic (18:1) and linoleic (18:2) acids [42, 43]. It is often use for human consumption and also as cosmetics.

Mahogany oil is extracted from kernels of Mahogany tree. *Khaya Senegalensis* (African mahogany) seeds have been discovered to be a rich source of oil that can be used for domestic and industrial purposes. Nigeria in particular, the seed oil is used as edible and for cosmetics. The seed has an oil content of 67 g, with Oleic acid (C18:1) 25.9 g, Linoleic acid (C18:2) 30.1 g and Linoleic acid (C18:3) 13.5 g Ali et al [44], Usman et al [45]. The oil also have medicinal purpose such as curing of ear diseases. It was said that, it can also be introduce in small amount into soup for healing of stomach problems.

Recent advances in improvement and uses of nigerian indigenous food products

There are many researches going on in the Nigerian country especially on how to improve the Nigerian indigenous food. Recent advances include preservation, complementation, fortification, and optimization. Others are fabrication of machines suitable for the processing of indigenous foods; planting of indigenous food processing companies and the use of selected suitable indigenous food into the Daily Menu of National Nutritional Guideline.

The recent advances are many. Nwobosi et al [46] studied the influence of pasteurization and use of natural tropical preservatives on the quality attributes of tiger nut drinks during storage. The study indicated considerable progress. In a similar study by Udeozor and Aworin [26] on comparative microbial analysis and storage of tiger nut-soy milk extract under ambient and refrigeration, indicated microbial stability under refrigeration. In another research on the effects of processing treatment on the quality of tiger nut milk, reviles microbial and organoleptic stability of packaged tiger nut milk Ukwuru and ogbodo [47]. Besides these, Udeze et al [26] showed that tiger nut milk can be blended with bamara nut milk or coconut milk. Also study by [23] indicated successes in yoghurt production from tiger nut, soymilk and cow milk mixtures.

In the area of juice, Instant Sorrel Drink (IZD) was already being developed by Mohammed et al. [10] through processing the purple sorrel calyx into powdery form by the method of infusion, dehydration and size reduction for long shelf life stability. It was also reported by DFNL [48] that Dala Foods Company has started market an instant Version. The instant powdered version the nutritious indigenous drink of *Sobo* is now in sachet similar to tea lipton and Top crown. The old version of the drink was said to be popular amongst low-income consumers in Nigeria. But now, this soluble alternative aims to reduce the health

hazards associated with existing production methods, while also creating a new market for Dala products at the base of the pyramid in Nigeria.

In another vein, the use of lima bean (*Phaseolus lunatus*) for the production of *Dawadawa* (a fermented condiment) was studied using molecular method (16SrRNA gene analysis) with a view to develop a framework for production of *Dawadawa* of consistence quality with starter culture of *Bacillus* species Farinde et al [49]. In another development, there was recent a research on *Ogiri* produced using a Nigerian designed and fabricated stainless steel solid state fermentar Onawola et al [50].

In terms of complementary foods; dried powdered *Ogi* flours from different cereal grains complemented with different legumes have been developed. Example, production of powdered maize *Ogi* (indigenous complementary food) flours complemented with soybean and sorghum malt; with the aim of improving the shelf life stability and at the same time increasing the energy density of gruel through complementation and viscosity reduction. Result obtained for this study were nutritionally appropriate and adequate Bristone et al [24].

Research into the use of cassava as a replacement for wheat has yielded promising results. Recipes were developed for making bread and a wide range of new food products; from either the 100% unfermented cassava flour or in combination with wheat flour. The new recipes included wheat–cassava composite bread (20% cassava flour and 80% wheat flour), meat pies, sausage rolls, cakes, biscuits, doughnuts, and chin-chin Abas et al [51].

Furthermore, modernized local *Gari* fryer was developed. This was designed and fabricated in response to the challenges facing local *Gari* processors such as exposure to smoke, formation of lumps and caking of products and through-put capacity improvement of processes Onu et al [37]. Also *Amala* making machine was developed. This machine was fabricated in Nigeria as a means of ensuring more hygienic and energy saving method of preparing *Amala* than the manual method [52].

More importantly, Lisabi Mills at a glance based in Lagos, is a food company that produces wide range of traditional and convenience foods marketed in Nigeria. Their core products include easy-to-prepare versions of traditional foods such as bean flour rich in 18.9 g protein fortified with vitamin A, B1, B2, B3 and iron (used to prepare *Moi Moi* and *Akara*), yam flour fortified with vitamin A, B1, B2, B3 and iron (used to prepare *Fufu*), wheat meal flour, as well as conventional convenience foods. It holds substantial market share in many of the product categories in which it operates. In marketing, the company competes with both multinational corporations, large Nigerian corporations and other mid-size companies [53].

In addition, Dala Food Company is into production of wide range of indigenous food products. These foods include instant *Kunun tsamiya* (protein 6 g, vitamin C, calcium), Diet *Kunun tsamiya* (protein 9 g, vitamin C, calcium), Instant fura (protein 12 g), Instant biski (protein 7 g), Action meal (protein 25 g, fortified with vitamin A) for women and children affected by HIV/AIDS and City tea a packaged black tea product [53, 54].

The National Council on Nutrition (NCN) and other government sectors are working on divers' issues that will improve the life of Nigerian populace. One of it is selection of suitable indigenous foods that will fit into the Daily Menu of Nigerian. A lot of Nigerian indigenous foods including *Ogi (akamu) Towu, Eba,*

Pounded yam, Moi-moi, Akara, Kulikuli, Kunun acha and Zobo drinks have already been documented on the Daily Menu of National Nutritional Guideline on Non-Communicable Disease Prevention, Control and Management [55].

Conclusion

It was observed that Nigeria as a country, have abundant crops and animals that could be used to feed her and the neighboring countries. Her indigenous foods are divers and abundant both in size and category; in nutrition and in health benefits, that if appropriately selected and processed could be used for all groups of refugees. The technology for processing and preserving those indigenous foods for later use were observed to be lacking and have put the country in food shortages due to wastage. Research evidence on many Nigerian foods was observed to be full of contaminants, certainly a way of undermining the available resources. Good technology for processing, packaging and preservation of those indigenous foods, would yield abundant wholesome foods for Nigerian refugees and other parts of the world. Lisabi Mills and Dala Food Company have started solving the problems associated with indigenous foods. Challenges of foods faced in Nigerian refugees camps and many parts of the world have similar cases. The dimension taken in this study is another approach of solving refugee problems and so also removal of hurdles against national development.

Recommendations

Nigerian government and institutions should do more on funding research in the universities, especially on matters that has to do with the health and nutrition of Nigerian populace. Governments and donors should come together to build indigenous industrial food business companies across all the six geopolitical zones of Nigeria and sustain them.

The following groups of microorganisms: bacteria (*Bacillus subtilis*, *Lactobacillus bulgaricus*, *Lactobacillus lactis* and *Leuconostoc oenos*), yeast (*Candida utilis*, *Kluyveromyces marxianus*, *Kluyveromyces lactis*, *Saccharomyces cerevisiae*) and moulds (*Aspergillus niger* *Aspergillus oryzae*, *Mucor javanicus*, *Penicillium roqueforti*) should be used for indigenous food production where there is need, since [56] reported that there is no need of obtaining permission from the regulatory authorities because they are Generally Regarded AS Safe (GRAS).

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