Original Research Article

Nutritional Composition of Some of the most Consumed Cereals and Legumes in Nigeria.

ABSTRACT

This study evaluated the nutritional composition of some of the most consumed cereals and legumes in Nigeria. The study is aimed at providing nutritional facts about these grains, which will guide its consumption based on nutritional requirement of individuals. These cereal grains were millet (*Pennisetum glaucum),* maize – hybrid IART, hybrid Oba super 6, hybrid Oba 98 and Native maize (*Zea mays*), rice (*Oryza sativa*) and sorghum (*Sorghum bicolor*) while legume grains were brown cowpea and black-eyed pea (*Vigna unguiculata*), soybean (*Glycine max*) and groundnut (*Arachis hypogaea*). These samples were sourced from different parts of Nigeria and handpicked to remove impurities and damaged seeds. The proximate composition (ash, moisture, carbohydrate, protein, lipid and fibre) and mineral contents (K, Na, Ca, Mg, Zn and Fe) were determined following standard procedures. The study showed that carbohydrate content ranged from 50.40 – 66.90% and 20.02 – 48.98% for cereals and legumes, respectively, while the protein content ranged thus: 10.36 – 18.38% and 17.50 – 23.19%. Rice and groundnut had the lowest fibre value of 2.64% and 3.84%, while the highest fibre value of 12.24% and 17.80% were obtained for maize hybrid Oba super 6 and brown cowpea, in that order. Ash content of sorghum was low (0.038%) and significantly different from other cereals (millet, maize varieties and rice) that ranged from 1.38 – 1.92% while brown cowpea had high ash content of 4.20% and other legumes ranged from 0.68 – 1.20%. The average moisture and lipid contents of cereals were 12.08% and 5.98%, respectively, while 14.24% and 14.17% were for legume grains. However, among the grains, groundnut's moisture and lipid content were 23.65% and 28.10%, which was significantly different from other grains. The mineral contents varied among the legumes. Black-eyed pea had high K, Ma and Ca contents when to others while groundnut had the least values for K, Mg, Fe and Zn. Brown cowpea had the highest Na and Fe contents. The study has shown that cereals and legumes have varied nutritional content and high nutritional content that is capable of sustaining the energy requirement of human system.

Key words: Cereals, consumption, legumes, nutrition

1. INTRODUCTION

Cereals are members of Poaceae family, cultivated for the edible components of its grains and are monocotyledonous in nature. They are grown in greater quantities and provide more food energy worldwide than any other type of crop [1]. Cereals over the years have form the basic

nourishment in the tropical and semi-arid areas of Africa and Asia [2,3]. Cereal grains are often ground into refined flour, but also as whole grains [4,5]. Their energy contribution in the food intake of West African Sahelian countries represents 63% on average. Rice, sorghum, maize, and pear millet are among the major cereals produced in Nigeria. They are the mostly grown in the savannah agro ecological zone of the country and are the most important sources of food. Cereal-based foods are a major source of energy, protein, vitamins and minerals for the world population. Generally, cereals are cheap to produce, are easily stored and transported, and do not deteriorate readily if kept dry. Cereal grains have been the principal component of human diet and have played a major role in shaping human civilization for thousands of years. Around the world; rice, wheat, and maize, and to a lesser extent, sorghum and millet are important staples and critical to daily survival of billions of people. More than 50% of world's daily caloric intake is derived directly from cereal grains consumption. Most of the grains used for human food are milled to remove the bran and germ, primarily to meet sensory expectations of consumers. The milling process strips the grains of important nutrients including dietary fibre, phenolics, vitamins and minerals which are beneficial to health [6].

On the other hand, legumes are believed to be one of the first crops cultivated by mankind and have remained a staple food for many regions all over the world [7]. They are dicotyledonous and may be annuals, biennials or perennials in terms of their habit. The commonly used legumes include alfalfa, chick peas, clovers, cowpeas, lentils, mung beans, kidney beans, peanuts, peas, pigeon peas, soybeans and vetches [8] and are referred to as grain legumes or food legumes. These seeds are valued worldwide as an inexpensive meat alternative and are considered the second most important food source after cereals. Legumes are nutritionally valuable; providing proteins with essential amino-acids, complex carbohydrates, dietary fibre, unsaturated fats, vitamins and essential minerals for the human diet [9,10]. Legumes include important grain, pasture and agro-forestry species, harvested as crops for human and animal consumption as well as pulp for paper production, fuel-woods, tuber, oil production, sources of chemicals and medicines, and are also cultivated as ornamental used as living fences and firebreaks among others. Many legumes are important in many zones of developing countries, where there is a pressing need for food sources of high energy and good quality protein. They are excellent source of resistant starch which is broken down by bacteria in the large intestine to produce short-chain fatty acids used by intestinal cells for food energy [11]. Legumes play an important role in many diets all over the world and are especially important in developing world countries like Africa, Latin America and Asia. Legumes have been labeled the 'poor man's meat' and this statement seem to hold some truth as observed in the consumption distribution in different regions, with an inverse relation between legume consumption and income being observed [12].

The aim of this study is to assess the nutritional composition of some cereals (millet, sorghum, rice, maize) and legumes (soybean, groundnut, brown cowpea and black-eyed pea) mostly consumed in Nigeria.

2. MATERIALS AND METHODS

2.1. Source of materials:

Millet (*Pennisetum glaucum*) and sorghum (*Sorghum bicolor*) samples were collected from the Nagari Seed Nigerian limited, Wusasa Zaria Kaduna State, while the rice (UPIA1), *Oryza sativa* was collected from the Faculty of Agriculture, University of Port Harcourt. Maize hybrid seed Oba 98 and Oba super 6, *Zea mays* were collected from Premier Seeds Port Harcourt, Rivers State while hybrid maize IART and native maize were collected from Ibadan, Oyo State. Legume samples [soybean (*Glycine max*), groundnut (*Arachis hypogaea*), brown cowpea and black-eyed pea (*Vigna unguiculata*)] were bought from Choba market in Port Harcourt, Nigeria. These cereals and legumes were handpicked to remove impurities, then crushed using an electric mill, after which they were weighed before the commencement of analyses.

2.2. Proximate Analysis: Proximate analysis (moisture, ash, protein, carbohydrate, lipid content and crude fibre) of the cereals and legumes were determined following the standard method of Association of Analytical Chemists of 1990 [13].

2.3. Mineral analysis: The legumes were digested using hydrochloric acid [14]. The mineral contents (Mg, Ca, K, Na, Zn and Fe) of the seeds were determined using Atomic Absorption Spectrophotometer (AAS).

2.4 Statistical analysis: The data collected were subjected to descriptive statistical analysis using Microsoft Excel 2013.

3. RESULTS

3.1 Proximate composition

The nutritional content of some cereals and legumes in relation to their proximate composition is presented in Table 1. It shows that cereals had more carbohydrate content than legumes while the reverse is the case for protein content. Among the cereals and legumes, respectively, the nutritional content differs from one grain to another. The ash content of brown cowpea was high compared to other assessed cereals and legumes.

Table 1: Proximate composition (%) of some cereals and legumes consumed in Nigeria

Crop	Type		CHO	Protein	Fibre	Moisture	Ash	Lipid
Cereal	Millet		58.54	15.66	6.18	11.30	1.92	6.40
	Sorghum		56.86	10.36	12.00	12.00	0.38	8.40
	Rice		66.90	11.22	2.64	14.03	1.51	3.70
	Hybrid maize Oba 98		53.04	16.63	9.71	12.84	1.81	5.97
	Hybrid maize Oba Super 6		56.07	14.00	12.24	10.21	1.38	6.10
	Hybrid maize IART		64.11	10.50	6.61	11.98	1.43	5.37
	Native maize		50.40	18.38	11.48	12.20	1.64	5.90
		Mean	57.99	13.82	8.69	12.08	1.44	5.98
		Stdev	5.834	3.211	3.643	1.191	0.507	1.392
Legume	Brown cowpea		43.30	17.50	17.80	14.20	4.20	3.00
	Black-eyed pea		48.98	18.35	17.52	11.00	0.95	3.20
	Soybean		40.83	21.87	6.16	8.10	0.68	22.36
	Groundnut		20.02	23.19	3.84	23.65	1.20	28.10
		Mean	38.28	20.23	11.33	14.24	1.76	14.17
		Stdev	12.644	2.735	7.371	6.751	1.642	12.990

CHO = Carbohydrate; Stdev = Standard deviation

3.2 Mineral Analysis

The mineral content of some assessed legumes varied in their mineral composition as shown in Table 2. The potassium content was higher in the legumes, followed by magnesium (Mg), calcium (Ca), sodium (Na), in that order, across the assessed legumes.

Table 2: The mineral content (mg/kg) of some legumes consumed mostly in Nigeria

Legume	K	Mg	Ca	Na	Fe	Zn
Brown cowpea	2454.00	1578.50	933.45	518.40	481.50	94.60
Black-eyed pea	2734.50	2320.50	1407.10	358.05	430.00	210.05
Soybean	2534.00	1978.50	1388.15	102.41	227.15	649.00
Groundnut	2479.50	1542.50	960.55	464.60	158.80	78.35
Mean	2550.50	1855.00	1172.31	360.87	324.36	258.00
Stdev	127.124	367.900	260.518	184.739	155.684	267.179

Stdev = Standard deviation

4. DISCUSSION

Carbohydrates are the major nutrient component of the cereal and legume grains. In this study, the carbohydrate content ranged thus: 50.40 – 66.90% and 20.02 – 48.98% for cereals and legumes, respectively. Ijabadeniyi and Adebolu reported slightly higher carbohydrate content values (65.63 – 70.23%) for the maize varieties grown in Nigeria [15]. For sorghum, Mustafa and Magdi [16] reported carbohydrate range of 68.34 to 69.65% which is slightly higher when compared to this study. In rice, carbohydrate was found in all the rice genotypes within the range of 51.50 – 86.90% [17]. The carbohydrate contents of legumes were lower compared to cereals in this study. FAO reported that staple foods such as millet, maize, rice and sorghum are high in starch which makes them absorbed a lot of water during cooking [18]. Amongst the grains, rice and black-eyed pea had the highest carbohydrate content for cereals and legumes, respectively. The study corroborated with common knowledge that cereals have more carbohydrate than legumes while the reverse is the case for protein. The legumes had protein content range of 17.50 – 23.19% while cereals had 10.36 – 18.38%. Similar study found the percentage protein content of three maize varieties grown in Nigeria in the range of 10.67 – 11.27% for the maize grains [15]. Jimoh and Abdullahi reported protein content ranged of 8.02 – 13.81% for five sorghum varieties analyzed [19]. The study showed that grains with high carbohydrate content had a corresponding low protein content. The fibre content of the cereals and the legumes were higher compared to the work of Ijabadeniyi and Adebolu [15], who reported range of 2.07 – 2.77% for grains grown in Nigeria. The Proteins Advisory Group of the United Nations suggested an upper limit of 5.0% crude fibre in supplementary foods. The high fibre content of these samples can have some biological beneficial effects such as laxative effect on the gastrointestinal tract, increased faecal bulk and reduction in plasma cholesterol level [20]. American Association of Cereal Chemists in 2000 defined dietary fibre as the edible parts of plant or analogous carbohydrates that are resistant to digestion and absorption in the human small intestine with complete or partial fermentation in the large intestine. Brown cowpea and millet had the highest ash content value. This signals a greater proportion of non-endosperm material in the grains because ash values indicate the level to which non-endosperm components are present. Ash content of any part of a plant is a function of the level of mineral. However, the study showed that average ash content of legumes was higher compared to the average ash content of cereals. Legumes contain more micro nutrients than cereals because legumes have higher initial mineral content. Many cereals are polished before eating while most legumes including common beans are consumed whole, resulting in conservation of their mineral contents. Legumes have more lipid content than cereals as shown in this study. The lipid content of groundnut and soybean is significantly different from other cereals and legumes assessed. These values were higher than the ones reported by others [19,21,22]. Ikram *et al.* observed lipid content of maize within the range of 3.21% to 7.71% [21]. Similarly, Jimoh and Abdullahi [19] documented that the lipid

content ranged from 5.30 – 10.54% for sorghum while Faustina and Cleopatra [22] reported 0.49 – 2.57% for rice varieties.

The minerals obtained from these grains in this study were higher compared to the work of others [23,24]. Salunkhe and Deshpande [23] reported mineral content of whole brown rice and polished rice as follows: Fe (30 and 10 mg/kg), Cu (3.3 and 2.9 mg/kg), Mn (17.6 and 10.9 mg/kg) and Zn (18 and 13 mg/kg). In twenty accessions of *Tetrapleura tetraptera*, average mineral contents were documented thus: Ca (1517.2 mg/kg), Fe (17.6 mg/kg), K (2507.3 mg/kg), Mg (882.7 mg/kg), Na (110.2 mg/kg), P (379.7 mg/kg) and Zn (8.0 mg/kg) by Uyoh *et al.* [24]. In horse gram, average concentrations of macro minerals (K, Ca, P, S and Mg) ranged from 1.3 – 14 mg and micro minerals (Cu, Fe, Ni, Zn and Mn) ranged from 1.0 – 95 μgm per gram dry weight [25]. The study has shown that legume grains have high mineral content that is capable of sustaining the energy requirement of human system.

5. CONCLUSION

The study has shown that some of the most consumed cereals and legumes in Nigeria varied in the nutritional composition and these cereals and legumes have high nutritional content that is capable of sustaining the energy requirement of human system.

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