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Comparative Studies of the Nutritional Compositions of Ten Powdered Adult Foods Commonly Consumed in Nigeria and Their Roles in Humans

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ABSTRACT: The markets in Benin City are currently 'saturated' with processed powdered foods from several sources which include wheat, maize, tubers *et cetera.* The demand for these products are also on the increase. It was against this background that ten adult powdered foods were purchased from the open markets in Benin City to evaluate their nutritive values. Consequently, the proximate analysis of the foods was determined. Additionally, the micro- and macro- mineral contents were determined with the AOAC and AACC methods. The results indicate that the moisture content was high in all the foods ranging from 7.40±0.21 % to 13.83±0.09 %. The lipid, ash, protein, fibre and carbohydrate contents were in varied concentrations from one food type to the other. Overall, the foods had high carbohydrate contents ranging from 13.12±0.09 % to 86.27±0.08 %. Most of the minerals determined were present in all the foods but in varied concentrations. The foods had high concentrations of Na, K, Ca, Mg, N and P, while the rest minerals were in low concentrations. 70 % of the foods had no detectable Mn. The concentration of sodium, potassium, calcium, magnesium, nitrogen and phosphorus ranged from 1.63±0.40 - 4.93±1.77 mg/kg, 1.26±0.18 - 93.00±1.73 mg/kg, 1.00±0.54 - 9.97±0.82 mg/kg, 1.00±00 - 7.97±0.82 mg/kg, 1.12±0.53 - 8.60±1.82 mg/kg, and 1.35±0.03 - 99.14±0.02 mg/kg respectively. Statistical analysis of the results showed that there were significant differences in the nutrient detected in some of the foods. In conclusion, these powdered foods would be able to contribute to the dietary nutrients required daily for growth, energy utilization and storage in their consumers.

Keywords: Powdered foods, Proximate analysis. Micro and Macro elements

Introduction

All living things cannot survive without food. Food is any nutritive material taken into the body for furnishing body fuel or energy, providing materials for growth and repair of body tissues and supplying substances that act to regulate various organic functions and processes. Some foods may be able to fulfil all three of these functions, but all of the functions must be served by our total diet if we are to maintain adequate health (Ajala, 2006). Additionally, foods are products derived from plants and animals that can be taken into the body to yield energy and nutrients for the maintenance of the body, growth and repair of tissues (Elliet and Sharon, 2005).

Nutrition is the intake of food, considered in relation to the body's dietary needs. Good nutrition and adequate balanced diet combined with regular physical activity is a cornerstone of good health. Poor nutrition can lead to reduced immunity, increased susceptibility to disease, impaired physical and mental development and reduce productivity (World Health Organisation, 2013). On the other hand, nutritional evaluation of food is the quantity, range and quality energy (calories), vitamins, minerals and phytochemicals

that are found in a food (White, 2013). The Romans were the first to grind seeds on cone mills. In 1879, at the beginning of the industrial era, the first steam mill was erected in London (Palmatier, 2000).

Among the advantages of powdered adult foods, it helps to prolong the shelf life of the food, done by reducing the water content of the food; the food is broken down in its natural biological environment; it eases marketing and distribution task thus enabling transportation of foods across long distances; it helps to eliminate waste of unprocessed foods and thus makes food available throughout every season. This study was undertaken to determine the nutritional compositions of ten adult foods commonly consumed in Nigeria.

Materials and Methods

Sample Collection and Storage: The ten powdered adult foods were purchased randomly from the open markets in Benin City, Nigeria. The powdered adult food samples were Beans Flour, Cassavita Flour, Corn Flour, Millet Flour, Pound Yam Flour, Plantain Flour, Rice Flour, Semolina
Flour, Semovita Flour and Whole Wheat Flour. Thereafter, the food samples were stored in an air-conditioned laboratory for 30 minutes before they were analyzed.

Experimental:
Proximate Analysis*:* The AOAC (2000) and AACC (2000) standard methods were adopted for the determination of the proximate components of the powdered foods while the carbohydrate was determined by difference.

Mineral determination*:* The assays of the mineral components of the foods were determined with a computerized Atomic Absorption Spectrophotometer, Unican series, Model 969. Five (5) grams of each of the food samples were weighed into a crucible and dried to ash in a Muffle furnace at 550 °C for 4 h. Thereafter, the contents were cooled in a dessicator and weighed.

Statistical Analysis: The Mean ± SEM for the parameters determined were compared for statistically significant differences by using the student's t- Test, while the analysis of variance was conducted with the BBSSTAT package.

Results

The results for the analysis of the ten powdered adult foods are presented in Tables 1 and 2. The ten powdered adult foods had moisture concentrations in varied amounts, which ranged from 7.40±0.21 to 13.83±0.09 %. Sample 2 had the highest concentration of moisture, followed by samples 7 and 8 with concentration of 12.53±0.27 and 11.63±0.18 % respectively. The least concentration was detected in sample 4 with 7.40±0.21 %. The analysis of ash indicated that ash was present in all the samples, while sample 1 had the highest concentration of 3.44±0.05 %, followed by sample 6 and 10 with concentrations of 2.81 ±0.01 % and 2.53±0.01 % respectively. The least concentration was detected in sample 8 with 0.25±0.02 %. The other samples had varied concentrations.

Table 1: Proximate analysis of ten powdered adult foods

Sample No	Sample Description	Moisture (%)	Lipid (%)	Ash (%)	Protein (%)	Fibre (%)	Carbohydrate by difference (%)
1	Beans flour	7.77±0.09	3.47±0.15	3.44±0.05	69.21±0.21	0.00±0.00	13.12±0.09
2	Cassavita + soya bean flour	13.83±0.09	2.00±0.12	1.42±0.11	3.50±0.17	0.00±0.00	79.25±0.11
3	Corn flour	11.50±0.17	1.73±0.89	0.28±0.01	0.22±0.01	0.00±0.00	86.27±0.19
4	Millet flour	7.40±0.21	4.50±0.17	2.15±0.03	28.93±0.01	8.25±0.01	48.77±0.32
5	Pound yam flour	11.31±0.25	0.20±0.58	0.84±0.02	1.76±0.03	6.24±0.02	79.65±0.25
6	Plantain flour	10.50±0.23	0.60±0.17	2.81±0.01	5.33±0.18	10.84±0.02	69.91±0.39
7	Rice flour	12.53±0.27	1.53±0.15	0.65±0.03	22.24±0.02	0.00±0.00	63.04±0.12
8	Semolina flour	11.63±0.18	0.43±0.12	0.25±0.02	3.24±0.02	15.81±0.02	68.55±0.26
9	Semovita flour	9.57±0.15	0.50±0.12	1.76±0.01	48.53±0.02	3.03±0.01	36.62±0.15
10	Wheat flour	9.23±0.15	1.73±0.12	2.53±0.01	20.40±0.10	3.03±0.01	63.07±0.26

The crude fat (lipid) was detected in all the adult food samples analysed. Sample 4 had the highest concentration of crude fat, followed by sample 1 and 2 with concentrations of 3.47±0.15 % and 2.00±0.12 % respectively. The least concentration was detected in sample 5, while the other samples had varied concentrations.

The crude protein was low in 60% of the food samples analysed. That is, samples 2,3,5,6, and 8 with 3.50±0.17 %, 0.22±0.01 %, 1.76±0.03 %, 5.33±0.18 %, and 3.24±0.02 %respectively. Sample 1 had the highest concentration of 69.21±0.02 %, followed by samples 9 and 4 with concentrations of 48.53±0.01 % and 28.93±0.01 % respectively. Crude fibre was not detected in samples 1, 2, 3 and 7. Sample 8 had the highest concentration of fibre with 15.81±0.02 %, followed by samples 6 and 4 with concentrations of 10.84±0.02 %and 8.25±0.01 % respectively. Sample 9 and 10 had the least concentration of 3.03±0.01 % respectively.

The carbohydrate contents in the powdered adult foods were generally high except in sample 1, where the least concentration of 13.12±0.09 % was detected. The highest concentration (86.27±0.19 %) was detected in sample 3, followed by samples 2 and 5 with concentrations of 79.25±0.11 % and 79.65±0.25 % respectively. The other samples were in varied concentrations.

The concentrations of zinc in the powdered foods varied from 4.00±1.15 mg/kg to 32.33±1.45mg/kg. Sample 10 had the highest concentration of zinc, followed by samples 2 and 7 respectively. Zinc was not detected in samples 1 and 3 (Table 2).

The iron concentrations in powdered foods analysed were in varied concentrations and ranged from 1.00±0.15 mg/kg to 97.33±1.15 mg/kg. Sample 7 had the highest concentration, followed by samples 6 and 5 respectively. Iron was not detected in sample 1.

Copper was not detectable in samples 1, 4, 9 and 10. Samples 5, 6, 7 and 8 had high concentrations of copper, 6.00±1.73 mg/kg, 8.00±1.53 mg/kg, 8.33±2.33 mg/kg and 9.00±1.73 mg/kg respectively.

Manganese was not detected in samples 1, 2, 3, 4, 5, 7 and 8, while sample 9 had the highest concentration of manganese, followed by samples 10 and 6 with concentrations of 24.33±2.33 mg/kg, 18.00±1.15 mg/kg and 3.00±1.15 mg/kg respectively.

The food samples had the concentrations of sodium in varied manner, while sample 5 had the highest concentration of 4.932±1.7 3mg/kg, followed by samples 1 (4.57±1.45 mg/kg) and 2 (3.85±1.73 mg/kg).

Calcium was detected in all the food samples analysed. Samples 7 and 8 had the highest concentrations of 9.97±0.82 mg/kg and 8.03±0.82 mg/kg respectively. The least concentration was detected in sample 9 with 1.00±0.54 mg/kg.

Magnesium was detected in all the food samples analysed. Sample 4 had the highest concentration of 7.97±0.82 mg/kg; followed by samples1and 6 with 5.97±1.82 mg/kg and 5.00±0.55 mg/kg respectively. The least concentration was found in sample 5 with 1.00±0.77 mg/kg. The other samples had varied concentrations of magnesium.

The nitrogen concentrations in the food sample assayed were in varied concentrations. Sample 6 had the highest concentration of 8.60±1.82 mg/kg followed by samples 9 and 4 with the concentrations of 7.24±1.82 mg/kg and 4.90±0.12 mg/kg respectively. The least concentration was detected in sample 1 with 1.12±0.52 mg/kg. The other samples had varied concentration.

Phosphorus was detected in all the food samples. Sample 3 had the highest concentration of 99.14±0.02 mg/kg, followed by samples 4, 5 and 10 with concentrations of 5.84±0.02 mg/kg, 5.55±0.02 mg/kg and 5.39±0.02 mg/kg respectively. The least concentration of phosphorus was detected in sample 2, with concentration of 1.35±0.03 mg/kg.

Discussion

The proximate analysis which gave the information about the nutritional composition of the food has shown that the ten powdered adult foods contained the necessary nutrient components required for healthy growth in man. For examples, moisture, crude protein, crude fat, ash, crude fiber and carbohydrate were detected in all the foods, though in varied concentration.

Table 2: Macro and micro-mineral compositions of ten powdered adult foods (Mean)

Sample No	Sample Description	Zn (mg/kg)	Fe (mg/kg)	Cu (mg/kg)	Mn (mg/kg)	Na (mg/kg)	K (mg/kg)	Ca (mg/kg)	Mg (mg/kg)	N (mg/kg)	P (mg/kg)
1	Beans flour	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	4.57±1.45	1.93±0.31	1.11±0.36	5.97±1.82	1.12±0.53	2.81±0.81
2	Cassavita +soya bean flour	26.67±1.86	42.67±1.76	4.67±0.88	0.00±0.00	3.85±1.73	1.67±0.83	1.11±0.31	4.97±0.53	5.59±1.82	1.35±0.03
3	Corn flour	0.00±0.00	16.00±1.5	4.67±1.45	0.00±0.00	2.87±1.15	93.00±1.73	1.00±0.77	3.07±1.64	4.00±1.32	99.14±0.02
4	Millet flour	10.00±1.15	1.44±1.15	0.00±0.00	0.00±0.00	1.63±0.40	1.94±0.45	1.10±0.33	7.97±0.82	4.90±0.12	5.84±0.02
5	Pound yam flour	18.00±1.15	64.00±2.31	6.00±1.73	0.00±0.00	4.93±1.73	1.87±0.15	1.60±0.55	1.00±0.77	2.90±0.77	5.55±0.02
6	Plantain flour	4.00±1.15	74.67±2.40	8.00±1.53	3.00±1.15	2.75±1.90	1.79±0.65	1.61±0.77	5.00±0.55	8.60±1.82	3.13±0.02
7	Rice flour	18.67±1.76	97.33±3.71	8.33±2.33	0.00±0.00	2.75±1.60	7.53±1.45	9.97±0.82	2.97±0.82	3.76±1.05	2.69±0.02
8	Semolina flour	2.33±0.88	1.00±0.21	9.00±1.73	0.00±0.00	2.63±0.73	1.17±0.40	8.03±0.82	4.03±1.55	5.21±0.82	1.68±0.03
9	Semovita flour	17.33±1.45	0.00±0.00	0.00±0.00	24.33±2.33	2.64±1.30	1.26±0.18	1.00±0.54	3.17±1.02	7.24±1.82	3.11±0.01
10	Wheat flour	32.33±1.45	8.00±1.15	0.00±0.00	18.00±1.15	3.23±1.76	1.96±1.33	1.01±o.82	1.10±0.82	3.30±0.82	5.39±0.02

The high moisture contents detected in all the powdered foods is an indication that the foods were not properly dried during processing. The immediate result of this is that, the shelf-life of the foods will be short and thus growth of micro-organisms in the foods would be enhanced. The presence of water and microorganisms in foods stimulate enzymatic activities that might lead to catalysis, hydrolysis, lypolysis, etcetera, which degrade the constituents of foods. High concentration of moisture results in the short-life of foods. Though, water is necessary in human diet for his survival, in processed foods, it should be eliminated to achieve a longer shelf-life, for the food.

In the case of the ash content detected in the foods, which is a measure of the total amount of minerals present in a food, it was observed generally that where high ash contents were detected, high mineral contents were also detected and vice versa.

The high carbohydrate contents detected in the powdered adult foods is an indication that the foods were rich in carbohydrate. Dietary carbohydrate is important in maintaining glycemic homeostasis, as a way of stressing the importance of carbohydrate (Food and Nutrition Board, 1998). The presence of high carbohydrates in foods serves several physiological functions in humans. For instance, it provides high energy storage and utilization. It acts as a metabolic "primer" for catabolism (Michael, 2006). Additionally, it is needed physiologically for the replenishing of glycogen stores in the muscles and to preserve tissue proteins for tissue growth and repairs (Michael, 2006). Arising from the glycemic load that might buildup in diabetes following the consumption of the analysed powdered adult foods, apart from samples 1 and 9, the adult foods would serve as a useful source of carbohydrate in human diet (Oboh and Obahiagbon, 2014).

The reasonable concentrations of fiber detected in some of the powdered adult foods might be due to the fact that the foods were prepared from fiber rich sources. Thus, the products could offer protection against certain diseases like cancer of the colon and increase bowel content transit time (Omale *et al*., 2010). Additionally, the fibers found in whole grain products are helpful in the treatment of constipation, haemorrhoid and weight loss (Anderson, 2011).

Despite the presence of high concentrations of carbohydrates which is an energy source, an additional source of energy yielding macronutrient was also detected. In this case, the lipid content which was present in all the foods. Lipid/fat serves as the main energy storage in the body and it is the most concentrated source of energy in diet. Additionally, lipids provide the essential fatty acids like linoleic acid (Omega 6) and alpha-linolenic acid (Omega-3) (Hu *et al*., 2009).

The ten minerals elements detected in all the foods, which are plant based, confirms and compliment results of earlier authors like, Obahiagbon (2008), Ndon (2003) and Oguntona (1986). These mineral elements detected in the processed plants foods obviously originated from the soils where the plants originated from (Mengel *et al*., 1979). The elements in the processed adult foods have significant roles in human physiology as reported by several authors here under. By implication, the consumption of these powdered foods would expose the humans to the roles of these elements in vivo. For example, zinc is essential for multiple aspects of metabolism which includes catalytic, structural and regulatory functions; and also plays an important role in the immune system. Iron which is an essential micro nutrient plays a vital role in oxygen transport, oxidation, metabolism and cellular proliferation. Iron rich food prevents anaemia (Madhavan *et al*., 2009). Copper is an essential nutrient that is necessary for hematologic and neurologic systems (Tan *et al*., 2006). It is necessary for the growth and formation of bone, formation of myelin sheaths in the nervous systems, it also helps in the incorporation of iron in haemoglobin (Murray *et al*., 2000). Manganese performs vital metabolic function in humans, they are needed to metabolize carbohydrates, cholesterol and amino acid (Garrow *et al*., 2000). Sodium is used by the body to control blood pressure and blood volume. In other words, it is essential for the maintenance of fluid balance in the body, for nerve activity and muscle contraction (Aronow, 2011). Potassium is an essential mineral element needed for maintaining total body fluid volume, acid and electrolyte balance and normal cell function (Young, 2001).

Potassium is effective in reducing blood pressure (Chang *et al*., 2006).Calcium is needed for normal growth and development of skeleton (Cashman, 2002). Adequate calcium intake is critical to achieving optimal peak bone mass and modifies the rate of bone loss associated with aging (National Institute of Health, 1999). Magnesium has beneficial roles in insulin sensitivity and risk of type 2 diabetes (Joanne, 2004). Besides, magnesium increases insulin secretion, also, it is known that diabetes is often associated with deficiency of magnesium (Fardet, 2010). Nitrogen in diet is needed by the human body for the synthesis or production of amino acids (Vernon, 2000).

Phosphorus is needed for growth, maintenance, and repair of all body tissues, and works in synergy with calcium and magnesium for proper growth and formation of bones (Heaney, 2004). Adults that feed on phosphorus rich food will not suffer from deficient bone mass formation (osteoporosis) and will have strong bones.

In conclusion, this research on the evaluations of the nutritional compositions of ten powdered adult foods has revealed that all the processed foods contained macro-nutrients like water, lipid, protein, fiber and carbohydrate apart from the presence of ten mineral elements. Additionally, the statistical analysis conducted on the ten powdered adult food samples revealed that significant differences existed between some of the nutrients, whereas this was absent in some. The nutrients detected have been documented for playing significant roles in human physiology. The proximate analysis result has shown that the foods are sources of energy to their consumer. Though the dietary fiber does not provide energy but it has several beneficial effects in human health, in reducing the risk of constipation and hemorrhoid formation, softens stools, lower blood cholesterol, increases bowel motility and reduces the exposure of gut carcinogens. On the other hand, the mineral constituents of the foods assists in metabolism, where they function also as cofactors in enzyme-catalysed reactions, forms synergy with other minerals in bone formation and strength and as constituents of body fluids and organs.

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