NUTRIENT COMPOSITION AND SENSORY EVALUATION OF COMPLEMENTARY FOOD PRODUCED FROM MULTI-GRAIN BLENDS

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ABSTRACT

Complementary foods are necessary for the infants around the first six months of life to avoid growth faltering, single plant based feed are insufficient in some micro nutrients hence multi grain food .The aim of this study was to produce a complementary food from multi- mixed grains. African Yam bean (Sphenostylis stenocarpa) Maize (Zea mays), Millet (Pennisetum glaucum) and Groundnut (Arachis hypogea). The formulated blends were produced in three different samples and each of them was analysed for its Proximate, Mineral, Anti- nutrient and Sensory properties. The samples included; sample A (50% Corn, 40 Millet, 5% African yam bean and 5% Groundnut), sample B (40% Corn, 40% Millet, 10% African yam bean and 10% Groundnut), sample C (100% Corn). Sample B had the highest energy, Protein, Fat, Carbohydrate Magnesium, Iron and alkaloid content 414.00±0.00, 11.33±0.58, 9.00±0.00, 80.79±2.86, 95.67±0.58, 4.33±0.56, 4.00±0.00 and had lowest moisture content 3.080±0.58. Zinc was 2.00±0.00 in all the samples. Sample C had the highest phytate 5.00±0.00. Sensory evaluation was done by comparing the samples with Cerelac infant formula, Sample B which contained (40% Corn, 40% Millet, 10% Groundnut and 10% African yam bean) was the closest to Cerelac infant formula, it is therefore recommended as a suitable complementary food.

Key Words: Nutrient, Sensory Evaluation, Complementary Food, Multi-Grain Blends

INTRODUCTION

The word 'Infant' is defined by World Health Organization (WHO) as a very young child from birth to somewhere between six months and two years of age, needing constant care and attention [1]. Complementary food is defined by the world health organization as any food or liquid other than breast milk. However, since many infants receive human milk substitutes from the first week of life, other authorities have suggested that the term complementary foods are required during the second part of the first year of life. According to WHO, if complementary foods are not introduced around the age of six months, or if not given appropriately, an infant's growth may falter [1]. The gap between nutritional requirements and amount obtained from complementary food increases with age. For energy 200, 300 and 550 kilocalorie per day is expected to be covered by complementary foods at ages of 6-8 months, 9-11 months and 12- 23 months respectively. In addition complementary foods relatively contains large proportion of micro nutrients such as iron, zinc, phosphorus, magnesium, calcium and vitamin B6. However, unfortified plant based complementary foods provide insufficient key micro nutrients especially iron, zinc and calcium during the age of 6 -23 months, hence the importance of a multi grain feed. A grain is a small, hard, dry seed, with or without an attached hull or fruit layer, harvested for human consumption [2], [3]. Thus, major global commodity market exists for canola, maize, rice, soybeans, wheat and other grains. One of the significance components in the whole grains that plays a significant part in its health properties is dietary fiber and phenolic, which are mainly concentrated in the outer layers of cereal grains. African yam bean (*Sphenostylis stenocarpa (Hochst.ex A. Rich) Harms)* is an herbaceous leguminous plant which belongs to the family Leguminosae (Fabaceae under exploited crops but good source of protein and energy cultivated in South – Eastern Nigeria for its edible seeds [4], [5],[6]. Maize (*Zea Mays L.)* also known as corn, is a member of the grass family (*Poaceae)*, Millets (Pennisetum glaucum) are small- grained,

annual, warm-weather cereals belonging to grass family and have a similar nutrient content to other cereals. [7]. Ground nut also known as (*Arachis hypogea)* is a leguminous crop grown mainly for its edible seeds being important to both small and large commercial producers.

MATERIALS AND METHODS

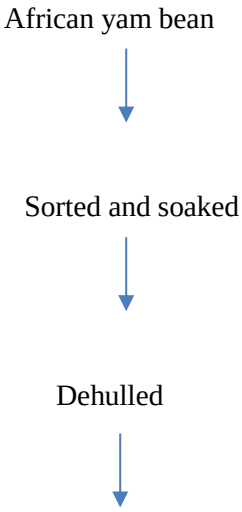
Sources of Materials

The raw African yam bean maize, millet, groundnut and cerelac infant formula were purchased in Bodija market, Ibadan, Oyo state, Nigeria.

Methods

The African yam bean was soaked for 2 days (48hours), after which it was sieved to facilitate the dehulling process and it was then dehulled and left to ferment for 48 hours after which it will be dried at 250^0 C for 20minutes and milled to fine powder with the aid of a milling machine.

The maize, groundnut and millet were sorted individually and roasted at 250^0 C for 20 minutes and then milled into fine powder the samples were then be mixed in ratio



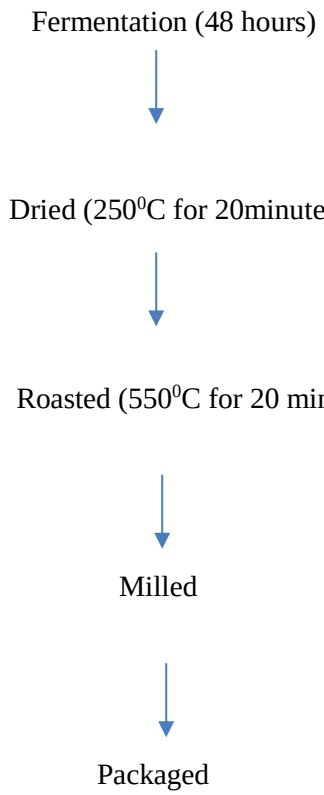


Fig 1**:** Flowchart of the processing of African yam bean

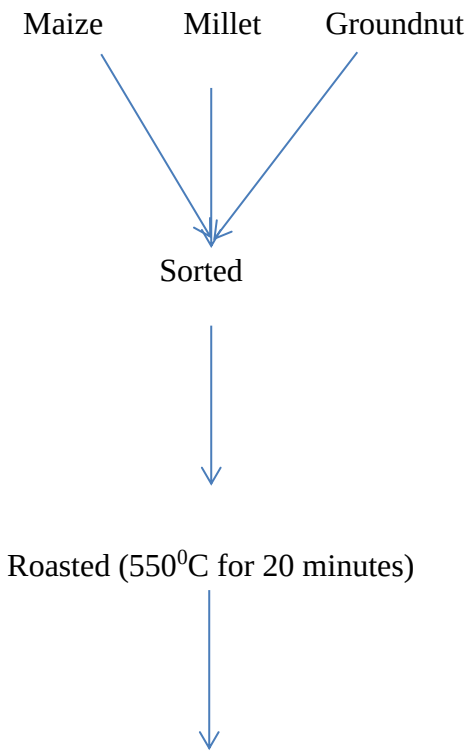


Fig 2: Flowchart for the processing of maize, groundnut and millet

FORMULATION OF THE BLENDS

The blends was divided into three groups

SAMPLE A: 5% of African yam bean, 5% of Groundnut, 40% of millet, 50% of maize

SAMPLE B: 10% of African yam bean, 10% of Groundnut, 40% of millet, 40% of maize

SAMPLE C: 100% of maize

DETERMINATION OF PROXIMATE COMPOSITION

The moisture content, ash content, crude protein, carbohydrate content, crude fibre, crude fat and anti- nutrient of the mixed grain was chemically analyzed according to the official method of analysis described by [8]. All analysis were carried out in triplicate.

SENSORY EVALUATION

The formulated blend was prepared into slurry by adding boiling water, to make a thick paste. Sensory evaluation was carried out using 9 point Hedonic Scale [9]. Sensory evaluation was carried out using 10 untrained panelists

Mineral content analysis

[8] methods were used to determine the mineral composition of the sample. 1gram of the sample was digested with nitric, perchloric and sulphuric acids mixture in ratio 9:2:1 respectively, filtered and the filtrate in a 5ml volumetric flask was loaded to Atomic Absorption Spectrophotometer, (model 703 Perkin Elmer, Norwalk, CT, USA). The standard curve for each mineral (calcium, magnesium, iron, zinc) was prepared from known standards and the mineral value of samples estimated against that of a standard curve.

Phytate Determination

The procedure used for phytate determination followed a method described by [10]

1gram of the powdered sample was put in the conical flask after which 30mls of 2%HCL was added and soaked for 3hours then filtered. 25ml of the filtrate was pipetted into conical flask and 5ml of 0.3% Ammonium thiocyanate was added. 53.5ml of distilled water was added and the solution was titrated against 0.005M ferric chloride ($fecl_2$) solution until a reddish brown color persist for 5 minutes. The phytic acid value was calculated using the formula (Titre value 0.00195x 1.19x100)**.**

Alkaloid determination

The alkaloid was determined using a method prescribed by [11]

5grams of the finely grinded sample was weighed into a 250ml beaker and 50ml of 10% acetic acid in ethanol (10ml of acetic acid into 9oml of ethanol) was added and covered and

allowed to stand for 4 hours .This was filtered and the extract was concentrated on a water bath to one quarter of the original volume. 5ml of 1N ammonium hydroxide was added in drop to the extract until the alkaloid was precipitated. The whole solution was allowed to settle and the precipitate collected was washed with dilute ammonium hydroxide and then filtered. The residue is the alkaloid which was dried in the oven at 300c and weighed. The alkaloid content was calculated using the formula.

$$\frac{W_3-W_2 \ X\ 1OO}{W_1}$$

Where W_1 is weight of dried filter paper

W_2 is the weight of the pre- weigh filter paper and

W3 is the weight of the sample.

STATISTICAL ANALYSIS

The data were analyzed using the Statistical Packaging for social sciences SPSS 20.0 version (IBM Statistics for windows).The mean and standard deviations of the analyses were calculated. The Analysis of variance (ANOVA) was used to determine the significant differences between the means while the means were separated using Duncan Multiple Range Test at $p \geq 0.05$

RESULT

Table 1: PROXIMATE ANALYSIS OF THE FORMULATED BLENDS.

NUTRIENTS	SAMPLE A	SAMPLE B MEAN±SD	SAMPLE C	P-VALUE
ENERGY(KJ/100g)	406.00±0.00	414.00±0.00	386.7±1.16	0.00
CRUDE PROTEIN (%)	10.67±1.16	11.33±0.58	9.00±0.00	0.21*

FAT (%)	6.00±0.00	9.00±0.00	3.33±0.58	0.00
CHO (%)	73.53±1.98	80.79±2.86	76.77±0.64	0.014
CRUDE FIBER (%)	1.67±0.46	2.76±0.12	1.79±0.35	0.014
MOISTURE (%)	4.00±0.00	3.08±0.58	3.33±0.00	0.03
ASH (%)	2.00±0.00	2.00±0.00	1.00±0.00	0.00

Values are means of triplicate determination **±SD**

Means with P≥0.05 have no significant difference

KEY:

Sample A =Corn, millet, groundnut and African yam bean (50:40:5:5)

Sample B = Corn, millet, groundnut and African yam bean (40:40:10:10)

Sample C= Corn (100%)

There was a significant difference (P≤0.05) in the energy content of the samples, sample B had the highest value (414.00±0.00), while Sample C had the lowest value (386.7±1.16). There was also a significant difference (P≤0.05) in the fat content of the samples ranging from 9.00±0.00 to 3.33±0.58 with sample B having the highest value. While the Carbohydrate content ranged from 80.79±2.86 to 76.77±0.64, with Sample B having the highest value. There was no significant difference (p>0.05) in means of crude protein among the samples, although sample B had the highest value of 11.33±0.58 and Sample C had the least value 9.00±0.00. The Crude fibre content showed a significant difference (P≤0.05) in the means of the samples with sample B having the highest value of 2.76±0.12 and Sample A having the least value of 1.67±0.46. The moisture content of the samples also showed a significant difference (P≤0.05) in the samples ranging from 4.00±0.00 to 3.08±0.58 with Sample A having the highest value.

Table 2: MINERAL COMPOSITION OF THE FORMULATED BLENDS.

NUTRIENTS	SAMPLE A	SAMPLE B	SAMPLE C	P-VALUE
		MEAN±SD		

CALCIUM	0.00±0.00	0.00±0.00	0.00±0.00	0.00
MAGNESSIUM	93.67±1.16	95.67±0.58	94.33±1.16	0.12*
IRON	3.00±0.00	4.33±0.56	2.00±0.00	0.42*
ZINC	2.00±0.00	2.00±0.00	2.00±0.00	0.00

Sample B had the highest value (95.67±0.58**)** of magnesium while sample A had the least value (93.67±1.16) with no significant difference (P<0.05). There was no significance difference (P≥0.05) in the means of Iron across the samples, although sample B had the highest value (4.33±0.56) and sample C had the least value (3.00±0.00). There was no calcium in any of the samples. The samples had the same value (2.00±0.00) for zinc.

Table 3:ANTI-NUTRIENT COMPOSITION OF THE FORMULATED BLENDS

NUTRIENTS	SAMPLE A	SAMPLE B	SAMPLE C	P VALUE
ALKALOID	2.33±0.58	4.00±0.00	3.33±0.58	0.01
PHYTATE	4.00±0.58	4.33±0.00	5.00±0.00	0.03

The anti-nutrient composition of the samples shows, Sample B had the highest value 4.00±0.00 of alkaloid while sample A had the lowest value 2.33±0.58. Sample C had the highest value 5.00±0.00 of phytate while sample A had the lowest value 4.33±0.00**,** there was a significant difference (p<0.05) in the means of anti-nutrients across the samples.

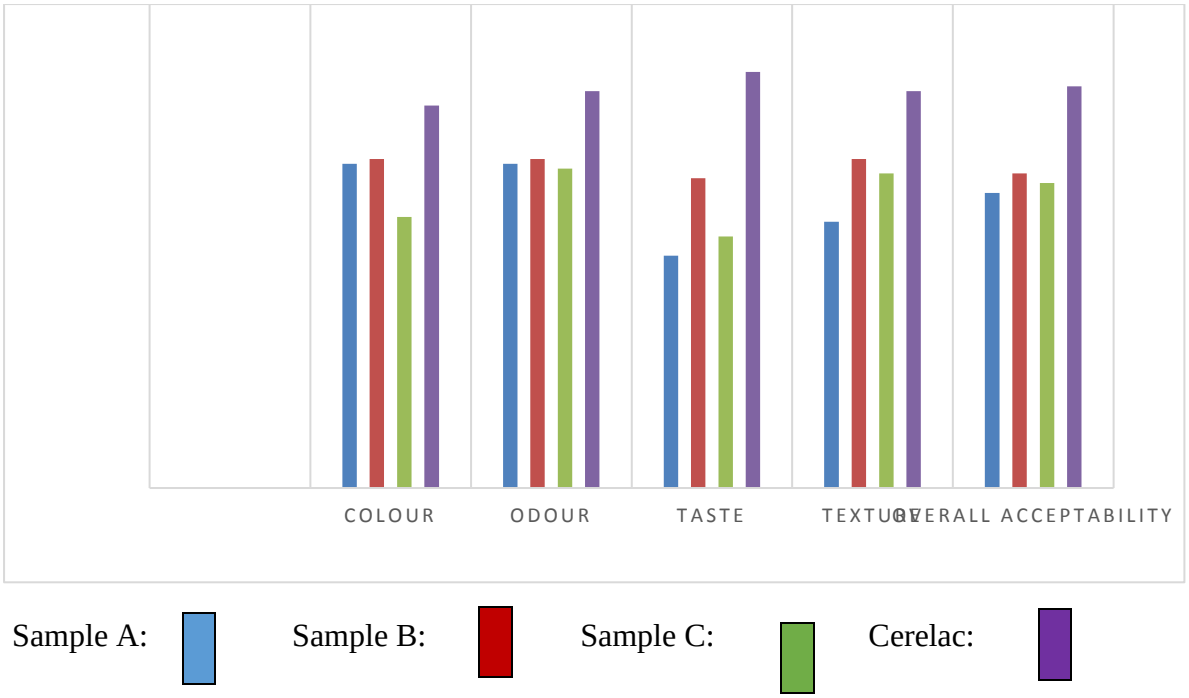


FIG 3: Result of the sensory evaluation of the formulated blends

The result of the sensory evaluation of the samples shows that there was a significant difference ($P<0.05$) in the colour of the samples with sample D having the highest value 7.90±1.45, although sample B had a higher value(6.80±1.27) than the control sample (Sample C) 6.70±0.95**.** There was a significant difference ($P\geq0.005$) in the aroma of the samples, ranging from 8.20±0.63 to 6.70±0.52 with sample D having the highest value, and sample B was higher 6.80±0.52 than sample C 6.70±0.79. Sample D had the highest value 8.20±0.79 for the textural quality, although sample B had a higher value 6.80±1.62 than the control sample C. There was a significant difference ($p\leq0.05$) in the taste of the samples, with Sample D having the highest value 8.60±0.52 while sample A had the least value 5.50±1.35, however sample B had a higher value 6.80±1.62 than the control sample.

DISCUSSIONS

The Proximate composition of the formulated blends, shows that the energy content ranged from 386.7±1.16KJ/100g to 414.00±0.00KJ/100g. The variation in the energy content of the sample could be due to differences in their protein and carbohydrate contents [12].Generally, the use of African yam bean flour in the preparation of complementary foods at a level up to 10% drastically improve their protein, ash, fibre and energy contents. The crude protein content of the samples increased significantly ($p \leq 0.05$) in sample B 11.33±0.58 due to the high level of African yam bean and groundnut, this support the findings of [13] *that* African yam bean is a good source of Protein. The fat content ranged from 2.00±0.00 to 3.33± 0.58 was almost the same with the one reported by [14] on infant porridges prepared from pearl millet. The low fat content in sample B is an indication that it has a good keeping quality which agrees with [15].The carbohydrate content of the samples ranged from 73.53±1.98 to 80.79±2.86, Carbohydrate is essential for generating energy. The crude fibre content ranged from 1.67±0.46 to 2.76±0.12 increased significantly ($p \leq 0.05$) with increased ratio of Corn, Millet and African Yam bean in the sample, this agrees with a study reported by [16]. The moisture content of the formulated blends ranged from 3.00±0.00 to 4.08±0.58, the values obtained in this study were lower than those reported by [17] for powdered cowpea flour. The low moisture content of the sample will enhance the shelf life of the complementary food and this agrees with the study carried out by [18] on powdered weaning foods fortified with germinated cowpea flour. The ash content of the samples were the same across the group implying that they are good sources of minerals which agrees with a study carried out by [19]. The most abundant mineral of the formulated blends was magnesium and the value ranged from 93.67±1.16 to 95.67±0.58**.** Magnesium which exist primarily as an intracellular constituent in the body could be of an advantage to health [20]. It is also the most abundant ion in plant cells, it is needed for more than 300 different enzymes system in the body [21]. There was no significant difference in the iron content ranging from

2.33±0.56 to 2.00±0.00 across the samples. Iron is an essential element for blood production, it plays such a crucial role in the body, it is important to maintain an adequate supply of iron to form haemoglobin and the other molecules in the body that depends on iron to function properly. For 6 months and above they are expected to consume at least 7mg of Iron per day [22]. Children with iron deficiency (Anaemia) have short attention span, studies have shown that iron deficiency leads to poorer developmental outcomes in infancy and childhood especially motor, cognitive, social emotional and neuro- physiological development in the short and long term [23]. Although the samples are deficient in calcium having 0.00±0.00 (mg/100g) in all the samples. This finding is low compared to that reported in a previous study by [24] on wheat-African yam bean composite flour cookies which calcium contents ranged from 10.28 to 11.65. While the values gotten for zinc was the same across the group 2.00± 0.00. Zinc is a trace element that is important in immune response, it plays an important role both before and after birth [25]. This findings showed that African yam bean flour is a good source of essential nutrients which are particularly of Public health significance [20]. Sensory evaluation of the complementary food agrees with the study done by [26]. The value ranged from the sample with the highest overall acceptability (Sample D) 8.30±0.95 to the sample having the lowest overall acceptability. There is significant difference ($p<0.05$) in means of all the sensory characteristics across the different food samples. There is a significant difference ($p<0.05$) in means of anti-nutrients across the samples. Phytate ranged from (5.00±0.00 – 4.00±0.00) and this could be attributed to the level of phytate in African yam bean [27].The phytic acid were lower than that reported by [28], [29], [30], [31]. Suggesting that the sample is safe for consumption [28]. Hence, the absorption of phosphorus will be easier and the body will be protected from foreign materials (heavy metals such as Cadmium, lead amongst others). It also serves as an anti-oxidant which helps the body to fight free radicals. There is a significant difference ($P<0.05$) in the means of alkaloid across the samples, Alkaloids also has health benefits such that it serves as lifesaving

drugs in some serious disorders like heart failure, cancer, blood pressure and other degenerative diseases [32].

Conclusion

This work showed the simple method of production of complementary food made from multi mixed grains. Sample B which contained (40% Corn, 40% Millet, 10% Groundnut and 10% African yam bean) was most accepted. Sample B was also found to have higher amount of Iron and Crude protein, it is therefore recommended as a suitable complementary food.

Recommendation

This formulation is therefore recommended as a complementary food and the formulated blends can further be evaluated for shelf life by carrying out microbial assay, determination of phytochemical properties and addition of calcium food.

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