ACTA SCIENTIFIC NUTRITIONAL HEALTH (ISSN:2582-1423)

Volume 4 Issue 1 January 2020

Research Article

Evaluation of Complementary Food from Blend of Fluted Pumpkin (*Telfairia occidentalis*) and Quality Protein Maize

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Received: November 25, 2019; **Published:** December 05, 2019

DOI: 10.31080/ASNH.2020.04.0563

Abstract

The use of under exploited oil seed plants are becoming more popular and relevant in various parts of the world due to their potentials in being used as protein substitute. Fluted pumpkin seeds which belong to this group are abundant in Nigeria. The study assessed complementary food formulated from Fluted pumpkin and Quality Protein maize in respect to a commercialized food in market. Proximate composition of the sample were evaluated which include crude protein, fat, moisture content, crude fiber and ash. Rat feeding method was used for nutritional quality determination. Formulated food and control diets were fed to albino rats for 28 days. Protein content of formulated diet was 17.57% compared to 9.0% of the Quality protein maize and 13.29 of the control sample GM and the microbial level is safe for consumption. Evaluation of protein quality revealed that the formulated diet compared favourably with casein diet at 10% iso nitrogenous protein level in all attributes studied. The high protein quality obtained can support growth of infants in developing countries.

Keywords: Quality Protein Maize; Fluted Pumpkin Flour; Complementary Food; Protein Quality; Microbial Quality

Introduction

Protein Energy Malnutrition (PEM) remains a major public health issue in the developing countries of the world of which Nigeria is a part. It appears to be recalcitrant due to the high level of poverty, overcrowding and Human immune deficiency virus (HIV)/Acquired immune deficiency Diseases (AIDS) in the developing countries.

Poverty is the underlying factor of majority of PEM in the developing countries. Statistical data from the World Bank shows that as at 2010, 68% of Nigerians lie on <1.25 dollars per day [1]. The trend of people living below the poverty line was similar in pattern with the trend of the severe malnourished among preschool children [2].

The traditional weaning foods from plant staples often fail to meet the nutritional needs of the infants, due to stiff consistency and high volume which combine to offer a low-cost filling meal that often lacks adequate nutrients [3]. They are therefore known to poorly support growth and development. Poor combination and formulation has partly contributed to the poor performance of traditional complementary foods. A number of researches [4,5]. in Nigeria have shown that a combination of cereals and legumes or tubers with vegetables and animal sourced food rather than the single diets, better supported growth and development. It is against this background that complementary food was formulated from Fluted pumpkin and Quality protein maize.

Fluted pumpkin (*Telfairia occidentalis*) is a tropical crop that belongs to the cucurbitaceae family [6]. The crop is reported to be indigenous to South Eastern Nigeria. Akoroda [7] reported that geography of cultivation suggested and intense Telfairia culture in the land stretching from Owerri to Umuahia and Ikwuano which adjoins the Ibibio area of the Cross River State and it is known as "ugu plant" in the Eastern part of Nigeria. Fluted pumpkin is solely propagated by seed [8]. During fruit maturation, those fruits selected for seed or planting are left to ripen fully on the plant while those for food are harvested while still tender.

Fluted pumpkin (*Telfairia occidentalis*) is playing an important role in human nutrition. Fagbemi [9] reported that the leaves and edible shoots together contain 85% moisture, and the dry portion of what is usually consumed contains 11% crude protein, 25% carbohydrate, 3% oils, 11% ash and as much as 700mg/kg of iron. This high level of iron seems to provide a basis for the folklore that Telfairia leaf extract is administered as a blood tonic to convalescent persons [7,9].

Fluted pumpkin contain appreciable amount of vitamin and minerals. Eziaba [8] reported the following in 100g seed flour. Vi-

Constituent	Content (g/100g dry sample)
Water	5.0
Protein	30.1
Fat	47.0
Ash	3.4
Carbohydrate	14.5
Phosphorus (mg)	710.0
Calcium (mg)	1.10
Iron (mg)	3.7

Table 1: Chemical Composition of Fluted Pumpkin Whole seed.

Source: [10].

tamin A 30IU, Vitamin B1 0.02mg, Nicotinamide 2mg, and Vitamin B2 0.2mg while there is no ascorbic acid.

Maize is a major food crop worldwide but has poor nutritional quality [11], it is a principal target for biofortification. Maize lacks adequate levels of the essential amino acids lysine and tryptophan, thus reducing the overall biological value of its protein [12]. In the 1960s, scientists discovered the opaque-2 (o2) gene, which almost doubles the lysine and tryptophan contents in maize protein. The gene improves the protein quality of maize drastically. Initial association of the o2 gene with soft kernels and poor agronomic performance was overcome and a group of new maize varieties was developed, collectively called QPM, with improved protein quality as well as storage and agronomic qualities similar to conventional maize [13,14]. Consumption of these varieties lead to greater protein utilization [15] and greater rates of growth among malnourished young children [16]. Many QPM varieties have now been released in different regions, in particular in East Africa under the QPM Development (QPMD) project [17].

There is little or no information on the use of Fluted Pumpkin for production of complementary foods. The objective of this study is to formulate high energy protein low cost complementary food from blend of QPM and Fluted Pumpkin and to evaluate its nutritional quality.

Materials and Methods

Source of raw materials

Sample of the Quality Protein Maize of yellow maize grains (ART 98/SW1) was obtained from the Institute of Agriculture, Research and Training (IAR&T) Moor Plantation Apata, Ibadan, Oyo State, Nigeria. Fluted Pumpkins seeds were obtained from local market in Ibadan, Oyo State, Nigeria. The control food sample (GM) was obtained from a reputable supermarket.

Sample preparation

Fermented maize flour production

The method described by [18] was used. Quality Protein maize (1.5kg) was steeped in 3litres of tap water at room temperature for three days. The steep water was decanted, and the fermented grains were washed with clean fresh water and wet milled. The bran was removed by sieving and the remaining solid matter 'Ogi' was allowed to settle. The water was decanted, and the ogi was further drained of water and air-dried for 24 hr and in the oven at 500C for 48 hr. The dry powder milled and kept in desiccators at room temperature until needed.

De-Fatted Fluted Pumpkin flour production

The seeds were dehulled, adhering testa were removed, sliced, washed and boiled for 1 hour as described by [19] and dried. The seeds were all dried at 50^0C, milled, sieved to pass through 200µm sieve and defatted using n-hexane solvent for 8 hrs and packaged in polyethylene containers for further analysis.

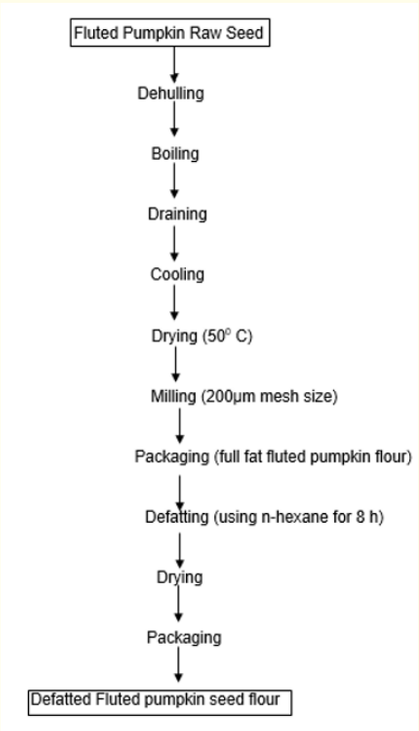

Figure 1: Flow chart for production of fluted pumpkin flour.

Formulation of the complementary diets

Graded sample mixture of the formulated diet was done, protein content of the blend was determined. Linear regression was used to arrive at blend of mixture that will give at least 17% pro-

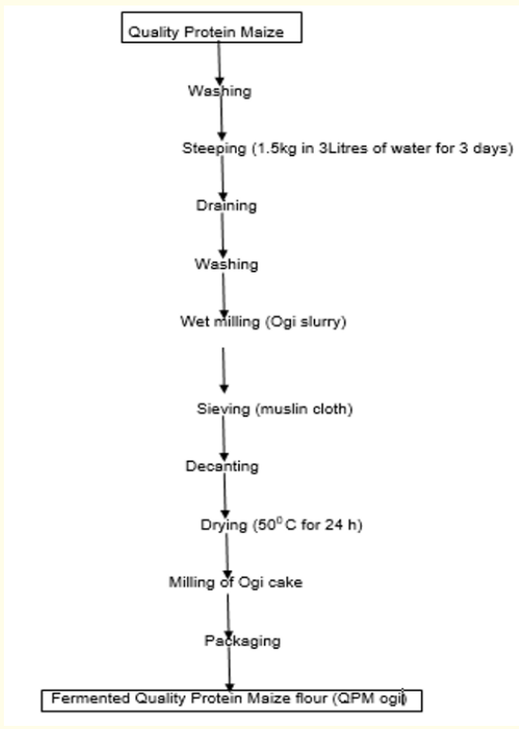

Figure 2: Flow chart for production of Quality Protein Maize flour.

tein. The complementary food was made into two samples: A made up of 100% Quality protein maize and B made up of blend of 76% Quality protein maize and 24% Defatted Fluted Pumpkin flour. The mixes obtained were thoroughly blended with a laboratory blender, packed, and sealed in high density polythene bags for further analysis.

Analytical Methods

Proximate analysis (moisture, protein, fat, ash and crude fiber) was carried out on the samples according to the methods described by [20]. Carbohydrate content was calculated by difference.

Microbial Analysis of the diets

The microbial loads, bacteria and fungi were determined as total viable count of microbes using the method described by [21]. The loads were expressed as the number of colony forming units (cfu) per gram of test sample. The spread technique was used. The solutions of the sixth (10^{-6}) and fourth (10^{-4}) dilutions were used for bacterial and fungal analysis, respectively. For bacterial culture, nutrient agar was used, while potato dextrose agar was used for fungal culture, 0.1cm^3 of the required dilution of the test sample was aseptically inoculated on the sterile growth media with the aid of a flamed glass hockey. The petri dishes were incubated in a gallenkamp incubator at 37^{0}C for 24h for bacteria and at room temperature for fungi. Counting of the colonies was done using Gallenkamp colony counter.

Biological Evaluation of the products

Twenty one wistar rats (Male and Female) weighing between 64 -65g were obtained from the animal breeding centre, Department of Veterinary Physiology and Pharmacology, Faculty of Veterinary Medicine, University of Ibadan, Ibadan. They were randomly distributed into three groups each consisting of 4% casein for a period of 5 days. After the 5 day period, the animals were reweighed and regrouped for control, basal and experimental diets. Water and food were given ad libitum. The diets were fed to the animals for a period of 28 days. This period is nutritionally accepted to be long enough to observe biological and chemical changes in animal tissues. Weighed diet was given and unconsumed diet collected and weighed daily, while live weight of the animals were determined and recorded twice a week throughout the experimental period. At the end of test period, the rats were re-weighed.

Biological Assessment of the diets

Raw materials	Composition (g/Kg)
Fermented Corn flour	647.5g
Glucose	50
Sucrose	150
Non nutritive cellulose	50g
Vegetable Oil	100g
Premix	20g
Oyster Shell	10g
Bone meal	20g
Sodium chloride	2.5g

Table 2: A basal diet was prepared according to Fanimo [22] as reported by [23]. Source: [23]

Statistical Analysis

The Result of the replicates were pooled and expressed as means ± standard error (S.E). A one way analysis of variance (ANOVA) and least Significance Difference (LSD) were carried out.

Results and Discussion

The result of the chemical analysis of the formulated diets (100% Quality protein Maize; Blend of Quality protein maize and fluted pumpkin seed flour) are shown in Table 3. The result showed Sample A (100% Quality protein maize) contained 9% protein, 4.22% fat, 76.68% Carbohydrate, 1.17% Fiber, 0.61% ash and 8.32% moisture; Sample B (Quality Protein Maize and Defatted Fluted Pumpkin flour) contained 17.57% protein, 4.08% fat, 66.88% Carbohydrate, 1.60% Fiber, 0.76% ash and 9.11% moisture and control sample GM 13.29% protein, 6.62% fat, 59.77% Carbohydrate, 7.06% Fiber, 3.52% ash and 9.74% moisture. There was significant difference observed between the results for protein, carbohydrate, and moisture ($p>0.05$). The protein (17.57%) and Moisture (9.11%) contents of the complementary food were higher than that of sample A (9.00% and 8.23%) and control sample GM (13.29% and 9.74%). The results of the fat and fiber for sample A (4.22% and 1.17%)) and sample B (4.08% and 1.60%) are lower than what was obtained for control sample GM (6.62% and 7.06%). The level of substitution favoured increase in protein. The calcu-

lated energy value of the sample A was 380.86kcal/g; sample B was 361.08 and control sample GM (339.75).These results was similar with those reported by [4,23,24].

Nutritional component of animal fed with the complementary Diet

Results of the biological evaluation of protein quality of the formulated diet and control diet are presented in Table 4. The results observed for protein qualities for the formulated diet was 0.21, 2.12, 1.24 and 19.90 for FER, PER, NPR and PRE respectively; 0.25, 2.54, 1.88 and 30.00 for Casein and 0.23, 2.31, 1.68 and 26.87 for GM control sample. There was significant difference ($P<0.05$) among the protein quality attributes of experimental diet compared to casein and GM control samples. Similar trends were observed for maize based complementary foods enriched with cowpea and soybean tempe [12], complementary foods from blends of fonio [26] and Quality protein maize and Conophor nut [24]. The results obtained from the study is within the same range reported in the literature (2.15 - 2.5).

Sample	Moisture	Crude protein	Total ash	Crude Fat	Carbohydrate	Crude Fiber	Energy
A	8.32^{c} ± 0.32	9.00^{c} ± 0.3	0.61^{b} ± 0.03	4.22^{b} ± 0.52	76.68^{a} ± 0.16	1.17^{b} ± 0.05	380.86^{a} ± 2.2
B	9.11^{b} ± 0.92	17.57^{a} ± 1.03	0.76^{b} ± 0.03	4.08^{b} ± 0.61	66.88^{b} ± 1.70	1.60^{b} ± 0.12	361.08^{a} ± 3.6
GM	9.74^{a} ±0.4	13.29^{b} ± 0.7	3.52^{a} ± 0.8	6.62^{a} ± 0.4	59.77^{c} ± 1.3	7.06^{a} ± 0.10	339.75^{b} ± 4.2

Table 3: Proximate composition of the formulated complementary diet.

Values are means ± standard deviations of triplicate determinations. Mean scores with the same superscript on the same column are not significantly different ($p<0.05$).

Key

A: 100% Quality protein Maize.

B: Formulated food (76% Quality protein maize and 24% defatted Fluted Pumpkin flour).

GM (control): Commercialized control sample.

Diet	Mean wt. Gain	Feed intake	Protein intake	Feed efficiency ratio (FER)	Protein Efficiency ratio (PER)	Corrected PER**	Net protein Retention	Protein Retention Efficiency	Feed conversion Ratio (FCR)
Casein	66	256	25.6	0.25	2.54	2.50	1.88	30.00	3.94
B	42	195	19.5	0.21	2.12	2.09	1.24	19.90	4.71
GM	62	268	26.8	0.23	2.31	2.28	1.68	26.87	4.32

Table 4: Biological response of rats fed with the formulated diets.

Key B: Formulated food (76% Quality protein maize and 24% defatted Fluted Pumpkin flour).

Table 5 shows the microbial loads of the formulated diet and control samples. Total Bacterial counts and Staphylococcus ranged between 1.1×10^{5a} and 1.0×10^{4a}cfu/g for sample A; 1.3×10^{5a} and 1.0×10^{4a}cfu/g for sample B and 1.2×10^{5a} and 2.0×10^{4a}cfu/g for control Sample GM. There was no evidence of Total coliform counts, Total fungi counts, *Escherichia col*i counts, *Salmonella* counts and *Shigella* counts. Presence of pathogenic microorganisms in weaning diet is not good for infant health because it causes diarrhea, vomiting and dehydration. Processing, packaging, storage, handling and environment are directly link to *Staphylococcus aureus* presence in food. This level is acceptable and it will not pose any threat to the consumer. Similar result was observed by [24,27].

Sample	Total bacterial counts (cfu/g)	Total coliform counts (cfu/g)	Total fungi counts (cfu/g)	Staphylococcus counts (cfu/g)	Salmonella counts (cfu/g)
A	1.1×10^{5a}	NG	NG	1.0×10^{4a}	NG
B	1.3×10^{5a}	NG	NG	1.0×10^{4a}	NG
GM	1.2×10^{5a}	NG	NG	2.0×10^{4a}	NG

Table 5: Microbial quality of formulated complementary diet.

Values are means ± standard deviations of triplicate determinations. Mean scores with the same superscript on the same column are not significantly different ($p<0.05$)

Key

A: 100% Quality protein Maize

B: Formulated food (76% Quality protein maize and 24% defatted Fluted Pumpkin flour).

GM (control): Commercialized control sample.

NG: No growth.

Conclusion

The investigation revealed that combinations of fluted pumpkin flour and QPM increased the protein quality and chemical composition of formulated diet. The Proximate composition of the formulated diet and biological evaluation showed that formulated diet quality is relatively close to result obtain from control sample (GM) and casein diet as obtained from rat feeding experiment.

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Volume 4 Issue 1 January 2020

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