



## **Quality Assessment of Weaning Food from Blends of Sorghum, Mung Beans and Orange Fleshed Sweet Potato Blends**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. Authors HTO and TOO contributed to design of the study, supervised the laboratory analyses, statically analyzed the data generated and interpreted it, wrote the manuscript (but the authors reviewed the manuscript and agreed on the manuscript submitted) while author EOT produced the flours and carried out all the chemical analyses as well as coordinated the sensory analysis sessions.*

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### **ABSTRACT**

Prevalence of Malnutrition continues to be a plague ravaging children all over the world especially in developing countries such as Nigeria. Development of inexpensive, nutritious and readily available foods can mitigate against the challenges of malnutrition.

**Objective:** To investigate the effect of different formulations of sorghum, mung beans and orange fleshed sweet potato flour blends on the proximate, functional, pasting properties and the sensory attributes of the weaning food blends.

**Methodology:** Weaning foods were formulated from Sorghum grains (S), Mung beans (M) and (O) Orange fleshed sweet potato in ratios 40:45:15, 40:30:30, 25:35:45, 25:45:30 and 55:30:15 respectively. The blends of the weaning food were analyzed for the proximate, functional, pasting properties and sensory evaluation using standard methods. Data obtained were subjected to analysis of variance and means were separated using Duncan's multiple range test  $p < 0.05$ .

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**Results:** The proximate analysis of the blends had moisture content (8.15-9.58%), crude fat (1.47-2.76%), crude protein (14.00-18.04%), crude fibre (0.34-0.82%), total ash (1.86-2.52%) and carbohydrate (68.02-73.62%). Functional analysis: Bulk density 0.55-0.65 (g/cm<sup>3</sup>), swelling power (4.64-7.13%), solubility index (4.00-16.50%), water absorption capacity 1.58 (g/gcm<sup>3</sup>). Pasting: Peak viscosity: (87-214), Break-down viscosity (64-142), Trough viscosity (16-72), Final viscosity (50-175), Set back (28-103), Peak time (4.4.6 min), Pasting temperature (70.83°C). Blend S:M:O-40:30:30 was rated most acceptable for all the parameters accessed.

**Conclusion:** The blends of the weaning food showed that it can be a good source of carbohydrate, crude protein, minerals with low bulkiness and good reconstitution properties which can be used to solve malnutrition challenges in Nigeria.

**Keywords:** Weaning foods; malnutrition; sorghum; mung beans; orange fleshed sweet potato.

## 1. INTRODUCTION

Malnutrition is a concern as regards to growth and development of young children in emerging countries. One of the challenges of malnutrition is the cost of nutritious foods mostly from animal origin which are often imported into Nigeria from developed countries, government restrictions on some of these foods also makes availability uncertain. Unemployment, increasing population, illiteracy, lack of knowledge on food composition, and rising cost of food, are factors influencing continuous malnutrition in developing countries which has necessitated the need to develop inexpensive nutritious foods from indigenous crops [1].

The rate of growth of an infant is a major indicator of its nutritional status. As a child is gradually weaned from breast milk, there is need for the child to be fed with highly nutritious foods containing essential nutrients such as carbohydrate, protein, fats, essential vitamins and minerals some of which may become inadequate in breast milk as a child advances in age.

Sorghum (*Sorghum bicolor*) is a whole cereal grain indigenous to Africa but consumed globally [1]. It is an excellent source of protein (11.5 to 16.5%), vitamins B<sub>1</sub>- B<sub>3</sub>, potassium, phosphorus, iron, sodium, calcium and calories more than other grains. Sorghum grains are rich in minerals such as calcium (Ca), potassium (K), iron (Fe), phosphorous (P) and sodium (Na). These nutrients improves the immune system, assist in blood cell building, boost appetite, relieves diarrhea, stimulates cardiovascular system, stimulates free flow of blood and lowers cholesterol levels [2]. These properties are very crucial to adequate growth and milestones in growing children.

Mung beans (*Vigna radiata*) is a leguminous plant similar to peas and lentils. Mung beans are mostly green in colour, but have few uncommon varieties which are yellow, brown, greenish yellow, and black. It is linear-cylindrical in shape. It can be eaten as cooked or sprouted. Mung beans protein is of high biological value and a good source of minerals (Manganese, Potassium, Magnesium, copper, zinc), vitamins (B<sub>s</sub>, C, K,) dietary fibre and crude lipid. These nutrients are very important for proper growth and milestones in children when they ought to occur [3].

Orange fleshed sweet potato (OFSP) is a root tuber commonly cultivated in Nigeria because of its easy adaptation to the soil and high beta-carotene which a precursor for vitamin A (VA). It is currently gaining a lot of attention in food formulations and development as one crop that can be used to tackle deficiencies of vitamin A (VAD) in growing children which is one of the aspects of malnutrition in developing countries such as Nigeria. Beta-carotenes are precursors of vitamin A (VA), which is responsible for different biological functions; such as visual cycle, genetic regulation and immunity [4]. Most varieties of sweet potato are excellent sources of calories, but notably Orange Fleshed Sweet potato (OFSP) variety has abundant Vitamins A and C [4].

Nigeria has a lot of nutrient rich, cheap, locally available plant crops which cut across cereals, roots tubers, legumes etc. that can meet the nutritional requirements for children if different blends/combinations/formulations are exploited. Therefore, there is need to investigate the blends of sorghum, mung beans and orange fleshed sweet potato which are inexpensive, locally available and nutrients dense in the development of weaning food and to determine effects of

different blends on the proximate, functional, pasting, and sensory evaluation of the weaning food to tackle the problems of malnutrition in children in emerging countries such as Nigeria.

## 2. MATERIALS AND METHODS

### 2.1 Collection of Materials

Sorghum (*Sorghum bicolor*) and mung beans (*Vigna radiata*) green variety were bought at Mushin market in Lagos, Nigeria and orange flesh sweet potato was obtained from Offa, Kwara State, Nigeria.

### 2.2 Preparation of Flours

#### 2.2.1 Sorghum flour

Sorghum flour was prepared by adopting the modified procedure of Hallen et al. [5]. The grains were cleaned thoroughly to remove physical contaminants, washed and soaked in water for 12 hrs. It was spread on jute bag afterwards to germinate for about three (3 days), after which it was dried in cabinet drier (D28, Nigeria) and milled using a locally made attrition mill into fine flour which was set aside until further processing.

#### 2.2.2 Mung beans flour

Green variety of mung (*Vigna radiata*) beans was thoroughly cleaned, weighed and steeped in water for 8 hrs to reduce the anti-nutrient, after the pre-conditioning treatments, it was dehulled abrasively to remove the hulls from the cotyledons. The water was decanted and the bean was left to germinate for 23 hours. It was dried in a cabinet drier (D28, Nigeria) at 65°C and was milled using a locally made attrition mill into fine flour and packed for further analysis [6].

#### 2.2.3 Orange fleshed sweet potato flour

Orange sweet potato flour was prepared using the procedure of Adeleke and Oyedeji [7]. The tubers were peeled, sliced and washed thoroughly in 1% NaCl solution for 30 minutes to inhibit oxidative browning reaction and to preserve its colour. The slices were dried in a cabinet drier (D28, Nigeria), at 55°C to achieve equilibrium moisture content. The dried potato slices were milled using a locally made attrition mill into flour and kept aside till needed.

### 2.2.4 Formulation of flour blends

Simplex lattice mixture design was used to obtain different percentages for sorghum (S), mung bean (M) and orange fleshed sweet potato (O) flour blends. The flour blends were prepared by combining sorghum, mung bean and orange fleshed sweet potato flour in the percentage proportion of 40:45:15, 40:30:30, 25:30:45, 25:45:30 and 55:30:15 after a preliminary trials respectively using Kenwood Food Processor, multi-pro (FP959, UK).

### 2.3 Proximate Composition of Sorghum, Mung and Orange Fleshed Sweet Potato Flour Blends

The proximate analysis (crude protein, crude fat, total ash, moisture, and crude fibre) of the blends was determined using AOAC [8].

### 2.4 Functional Analysis of Sorghum, Mungs and Orange Fleshed Sweet Potato Flour Blends

#### 2.4.1 Swelling capacity and solubility index

The procedure of AOAC [8] was employed and calculated as:

$$\text{Swelling power} = \frac{\text{weight of sediment}}{\text{sample weight} - \text{weight of soluble}} \quad (1)$$

$$\text{Solubility index} = \frac{\text{weight of soluble}}{\text{weight of sample}} \times 100 \quad (2)$$

#### 2.4.2 Bulk density

The bulk density was done using AOAC [8] and calculated as:

$$\text{Bulk density (g/ml)} = \frac{\text{weight of sample}}{\text{volume occupied}} \quad (3)$$

#### 2.4.3 Water absorption capacity

Water absorption capacity was analyzed using the procedure of Makkar and Goodchild [9] and calculated as:

$$\text{WAC (\%)} = \frac{\text{amount of water absorbed in gram}}{\text{weight of sample}} \quad (4)$$

#### 2.4.4 Pasting characteristics of the blends of sorghum, mungs and orange fleshed sweet-potato

Pasting analysis of the formulations was analyzed with Rapid Viscosity Analyzer (RVA), (model DA, 6200™ NIR, UK) Analyzer.

## 2.5 Determination of Tannin Content of the Blends of Sorghum, Mungs and Orange Fleshed Sweet-potato

Tannin content was determined according to the procedure of Makkar and Goodchild [9].

## 2.6 Sensory Evaluation

Consumer acceptance of the weaning food prepared from the blends of sorghum, mung beans and orange fleshed sweet potato was done by 30 nursing mothers who are familiar with established brands of weaning food products. The plates were coded to differentiate the samples before serving it at random with water to rinse the mouth after each testing. The samples were evaluated for taste, colour, flavour, aroma, appearance, mouthfeel and overall acceptability. Attribute were scored on a 7-point Hedonic scale (1 –dislike extremely and 7 – like extremely) [6].

## 2.7 Analysis of Data

Data of all the analysis were evaluated statistically using the SPSS software package version 16.0, mean values were separated with Duncan multiple range test at 5% level of significance ( $p < 0.05$ ).

# 3. RESULTS AND DISCUSSION

## 3.1 Proximate Composition of Sorghum, Mung Beans and Orange Fleshed Sweet Potato Flour Blends

Results of proximate composition of the blends of sorghum, mung beans and orange fleshed weaning food are shown in Table 2. Significant differences ( $p < 0.05$ ) were observed in all the formulations. The protein content ranged between 14.00 and 18.4%. Sample 25:45:30 had the highest crude protein and 40:30:30 the least crude protein. Protein is important in building the fragile body tissue of babies, essential to development and regulation of important body processes. It represents the essence of life which is development in children [10]. The trend of increase in crude protein contents across the samples can be attributed to increase in substitution ratio of mung beans and sorghum. FAO/WHO Codex Alimentarius Standards for complementary/weaning foods stipulates that the percentage of protein content should be between 14.52 and 37.70 g/100 g in order to have a complementation balance between proteins (amino acids) of lower and higher biological

value for balancing to meet appropriate demand for growth [10]. Sample 25:45:30, 25:35:45 and 55:30:15 satisfies the required standard protein percentage of complementary/weaning food for infants while 40:45:15 and 40:30:30 were below minimum standard percentage (14.52%). The values for crude protein (14.00-18.04%) observed in this study was in line with the value of (7.29-19.19) reported by Bolarinwa et al. [11] on malted sorghum-soy composite flour.

Moisture content is one of the major indices influencing shelf-stability of foods. Low moisture content implies low water activity which means moisture will not be available for micro-organism which is the principal agent of spoilage to act freely on the formulations. Less than 10% moisture content is recommended for better keeping quality [5]. Moisture content of the formulations were between 8.15 and 9.58%. Sample 55:30:15 had the highest moisture values and 25:35:45 the least. The moisture content the blends were within the recommended values for weaning/complementary foods. Ebunoluwa et al. [12] reported similar moisture content values (7.11-9.40) on orange fleshed sweet potato, sorghum and soybean complementary food.

Lipid content of a food sample is a measure of the fat level for a particular intended use. Rancidity and off-flavour are the attending effects of high fat in a flour blend. Crude fat ranged between 1.47 and 2.76%. Sample 55:30:15 had the highest fat content which also is the sample with highest sorghum supplementation; the oil may be from the germ component as the sorghum was milled as whole grain while formulation 25:35:45 had the least sorghum inclusion as well as fat content. The values 1.47 to 2.76% observed in this study were similar to the values (1.40-2.70%) reported by Agugo et al. [13] on mung beans-maize weaning food.

Crude fibre is the quantity of indigestible cellulose, pentosans, lignin and other food components [14]. It is responsible for inhibition and amelioration of the etiology of many diseases. Crude fibre varied from 0.34 and 0.82%. There were significant ( $p \leq 0.05$ ) differences among the blends. The values obtained (0.34 – 0.82%) is within the range as stipulated by Protein-Calorie Advisory Group (PAG). The crude fibre of diet meant for infants is expected to be  $< 5\%$  because of their developing digestive system. All the samples had a minimal crude fibre and were within the stipulated standard for weaning foods.

Total ash, which represents the amount of mineral composition present in food, and it varied between 1.86 and 2.52% across all samples. Sample 40:45:15 had the highest total ash suggesting that the bran of the sorghum and mineral contents in mung beans could have contributed to the mineral composition while sample 55:30:15 with lower mung beans supplementation had the least mineral content. The ash content varied across the formulations; as the substitution of mung beans flour and sorghum flour increased the total ash also increased. The values (1.86-2.52%) of total ash observed in this study are within the reported values (1.50-3.14) of [11] on sorghum-soy composite flour.

The carbohydrate content ranged between 65.02 and 73.62%. Sample 40:30:30 had the highest carbohydrate content which could be attributed to the amylose and amylopectin components of the starch in orange fleshed sweet potato and the sorghum grain while sample with the least sorghum substitution 25:45:30 had the least value. Carbohydrates are the most important and readily available source of energy. They are also important in brain, heart, nervous, digestive functions and immune system [15]. The carbohydrate content of the weaning food samples shows significant ( $p>0.05$ ) differences between the formulations. Values (65.02-73.62%) observed was within the range of values (63.7%-77%) reported by [16] for carbohydrate on sorghum-cowpea complementary food.

### 3.2 Functional Analysis of Sorghum, Mungs and Orange Fleshed Sweet potato Flour Blends

Presented in Table 3 are results for functional analysis of the blends of sorghum, mung beans and orange fleshed sweet-potato of the weaning food. Bulk density represents the porosity of a sample and wettability which determine the design of the packaging [17]. The bulk density varied between 0.55 and 0.61 g/cm<sup>3</sup>. The bulk density shows no significant ( $p>0.05$ ) differences among the samples. Soaking and germination reduced the bulk density as starch granules were hydrolyzed during germination of sorghum and mung beans. Process of germination has been used in food formulations especially weaning food to produced low bulk foods as reported previously by several authors such as [18] and the outcome in this study are similar to all the bulk density values obtained. The effect of

soaking and germination on the blends is similar to the findings of [18] on the effect of germination and fermentation of pearl millet. Low bulkiness is an important attribute in weaning food formulations to avoid constipation and suffocation in young children whose digestive systems is still developing. The value for all the samples is within range (0.56-0.96 g/ml) reported by [19] on Popcorn, Groundnut and African locust bean flour infant formula.

Swelling power measures hydration capacity; it is determined by measuring the weight of swollen starch granules and their natural water in the food matrix [20]. The swelling power ranged between 4.64 and 7.13 g/g. The higher the swelling index, the greater the associate forces [21]. Significant difference ( $p<0.05$ ) existed between the samples. The values 4.64-7.13 g/g obtained is similar to the values 1.85-22.30 g/g reported by [22] on composite flours.

Solubility Index describes the extent of solubility of a sample and its potentials to gelatinize with much residual particles. It is an important parameter which ultimately ascertains the consistency of gruels [23]. Flours with high solubility index values hold more water during their preparation into gruels and this becomes watery with a low energy and little or no nutrient. The solubility index ranged between 4.00 and 20.50%. Sample 25:35:45 had the highest value and 40:45:15 the least value. Significant ( $P<0.05$ ) differences were observed among the blends of the weaning food.

Water absorption capacity (WAC) results show that sample 40:45:15 and 40:30:30 had the least WAC (1.58 g/g) and 25:45:30 had the highest WAC 1.79 g/g with no significant ( $p>0.05$ ) difference. WAC gives information about the potentials of a product to take up water under limiting conditions. Osundahunsi et al. [24] stated that WAC is a desirable attribute for reconstitution and yield of food, consistency and improve bulkiness of the food. Sample 40:45:15 and 40:30:30 had the least WAC (1.58 g/gml<sup>-1</sup>). As the inclusion of sweet potato flour decreased WAC also decreased. The values observed in this study 1.58-1.79 gml<sup>-1</sup> is lower than the values 2.20-4.85 gml<sup>-1</sup> reported by [25] on Teff fortified with soybean and orange fleshed sweet potato weaning food but similar to the values 0.14-1.83 g/g reported by [26] pigeon pea-millet weaning foods. The low WAC of different flour blends suggests the flour blends will have good water binding ability.

### 3.3 Pasting Analysis

Table 4 is the result of the pasting analysis of the different formulations of the weaning food. Pasting analysis describes the potentials of a flour to form a paste. According to [27], starch granules when heated becomes hydrated, increase, and changes into a paste. Peak viscosity ranged between 87 and 214 RVU, while sample 40:45:15 had the highest value and 55:30:15 with least peak value. Peak viscosity is a measure of the ability of starch to form a paste on cooking [28]. Peak viscosity depicts the maximum achievable swelling starch granules can attain, before retrogradation sets in. [29], described it as the latent transition point between swelling and breakdown of starches. Trough viscosity is between 16 and 72 RVU, sample 40:45:15 had highest and 55:30:15 the least. Trough viscosity measures the potential of the formulations to form paste or gel without collapsing during cooling [30]. The values 16-72 RVU observed in this study were totally different from the values 17.71-263.96RVU reported by [31]. Final viscosity varied between 50 and 175 RVU, 40:45:15 had the highest final viscosity and 25:35:45 the least final viscosity. Final viscosity depicts the potential of the flour to form a viscous paste or gel after cooking and cooling, and also the resistance of a paste to shear force during stirring [32]. Sample 40:45:15 is more cohesive during stirring. The values 27.00-103.00 RVU obtained were different from the reported values 2.08-111.38RVU by [31] on unripe cooking banana, pigeon pea and sweet potato complementary food.

Setback ranged between 27 and 103 RVU, sample 40:45:15 had the highest and 25:35:45 had the lowest value. Breakdown ranged between 64 and 142 RVU, sample 40:45:15 had the highest and 40:30:30 had the least break down values. Breakdown is the difference between the peak and the trough viscosities. Breakdown measures the ability of the material to withstand heating and shear stress during cooking [33]. Peak time was between 3.87 and 4.60 min, with sample 40:45:15 with peak time of 4.60 min and sample 25:35:45 with the peak time of 3.87 min. The peak time is the total time taken by each blend to attain its respective peak viscosity. The peak time recorded in this study 3.87-4.60 mins is similar to the peak time (2.93-5.46 mins) reported by [34] on peak time for selected sorghum varieties and soybean while the pasting temperature values 80.70-82.25°C was similar to the values 70.00-85.00°C reported

by [14] on malted sorghum-soy composite flour. The result of the pasting temperature shows that the starch will begin to rise between 70 and 85°C during preparation of the gruel.

### 3.4 Anti-nutrient

Presented in Fig. 2 is the result of the tannin content. Tannins form complexes with proteins (both substrate and enzyme) in some food products, and as such prevent the utilization of the nutrients [35] in the digestive system. The tannin content 0.0495 and 0.0573 mg/ml contained in the blends of sorghum, mung beans and orange fleshed sweet potato weaning food samples were low. This may be due to soaking and germination of sorghum and mung beans. Soaking and germination is reported to reduce tannin content of legumes or cereal which could be due to the leaching out of tannin during soaking [36]. The tannin contents observed across the blends shows that the blends are safe for consumption for children.

### 3.5 Sensory Evaluation

Fig. 3 is the results of the sensory evaluation of the blends of sorghum, mung beans and orange fleshed sweet potato weaning food samples. Taste determines acceptance or rejection of food and influences success of any food product in the market [37]. Sample 40:30:30 and 25:35:45 were the most accepted based on the texture and consistency. The taste was affected by the beany flavour of the mung beans. The values 6.00-7.05 observed for taste attribute is similar to the values 4.48-7.29 reported by [38] for malted cereals, soybeans and groundnut complementary food. Colour ranged between 6.5 and 7.60. Sample 25:35:45 had the best colour score and sample 40:45:15 the least score for colour. Colour provides information about the formulation and quality of a product [39]. Sample 25:35:45 was the most accepted in terms of colour. This may be due to the colour imparted by the orange fleshed sweet potato. Nanyem et al. [40] values reported 5.80-8.10 for wheat, Acha and mung beans composite flours similar to the values observed (6.50-7.35) in this study.

Aroma ranged between 5.80 and 7.10. Sample 25:35:45 had the best aroma scores and sample 40:45:15 had the least accepted aroma. The scores observed for aroma in this study 5.80-7.10 is similar to the scores 6.00-7.41 reported by [14] for malted sorghum-soy composite flour. Appearance ranged between 6.80 and 7.15

Sample 40:30:30 had the highest value for appearance of the weaning food while sample 40:30:30 had the least score for appearance. The appearance of a food product gives aesthetic appeal to the consumers. Sample 25:35:45 had the best score for appearance amongst the blends. This may have resulted from the substitution level of orange fleshed sweet potato flour. Mouthfeel of the weaning foods ranged between 6.60 and 7.10, sample 25:35:45 had the highest score for mouth-feel and sample 55:30:15 the least score. Sample 25:35:45 had the best mouth-feel.

The overall acceptability of the weaning food had scores which ranged between 6.25 and 7.30 across the samples. Consumers determine the acceptance of a food product from their perception of the product based on the known quality attributes of the food. Sample 40:30:30 was the most preferred for the overall acceptability of the blends probably due to the high quantity of the sorghum flour as gruel from sorghum is one of the common weaning food in Nigeria. The values obtained 6.25-7.30 in the study is within the values 5.67-8.14 reported by Osuntogun et al. [35] on malted cereals, soybeans and groundnut complementary food.

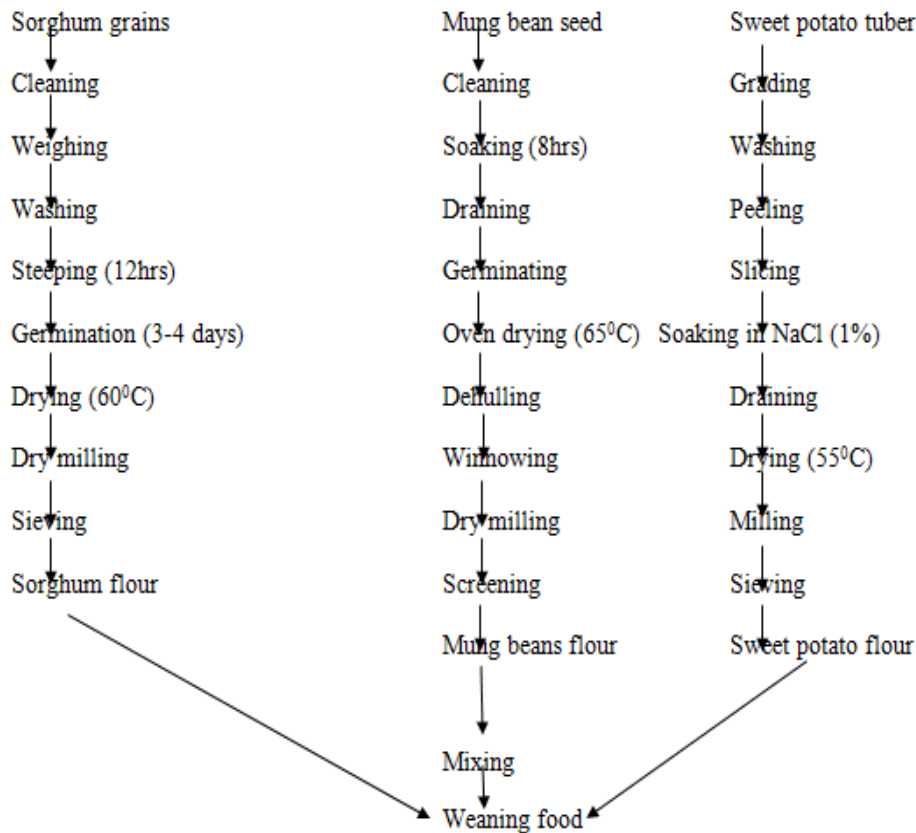


Fig. 1. Flowchart for the production of sorghum, mung and sweet potato composite flours  
Source: [5,6,7]

Table 1. Blend ratios of the weaning food composite flours

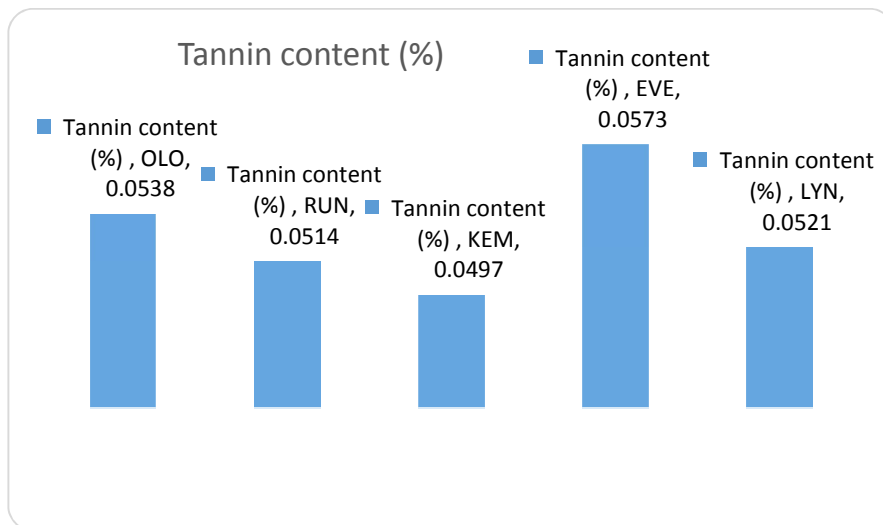
S:M:O	Sorghum flour (%)	Mung beans flour (%)	Orange sweet potato flour (%)
40:45:15	40	45	15
40:30:30	40	30	30
25:30:45	25	30	45
25:45:30	25	45	30
55:30:15	55	30	15

S- sorghum, M-mung beans, O-orange fleshed sweet potato

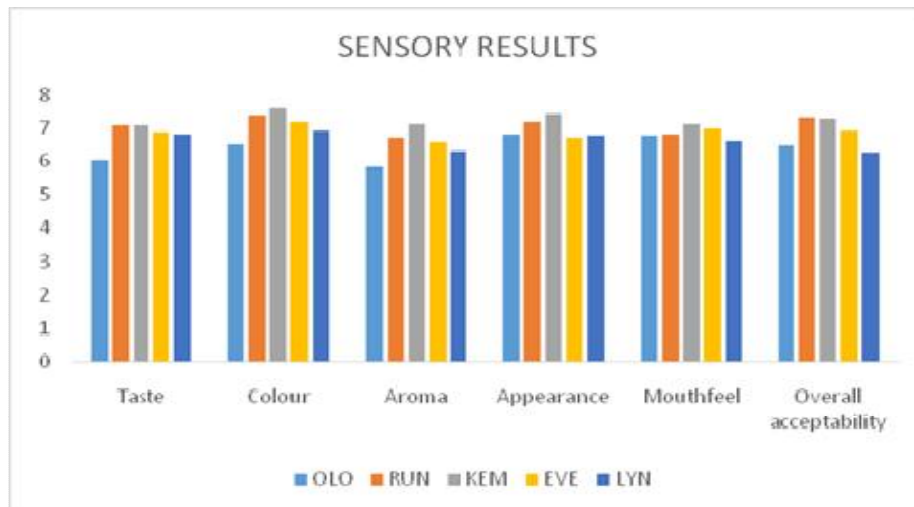
**Table 2. Result of proximate composition of the blends of weaning food**

S:M:O	Moisture (%)	Crude fat (%)	Crudeprotein (%)	Crudefibre (%)	Total ash (%)	Carbohydrate (%)
40:45:15	8.62±0.11 <sup>c</sup>	2.42±0.14 <sup>c</sup>	14.50±0.39 <sup>a</sup>	0.60±0.05 <sup>b</sup>	2.52±0.42 <sup>c</sup>	71.32±0.18 <sup>c</sup>
40:30:30	8.28±0.04 <sup>ab</sup>	1.55±0.52 <sup>ab</sup>	14.00±0.09 <sup>a</sup>	0.34±0.04 <sup>a</sup>	2.22±0.05 <sup>b</sup>	73.62±0.56 <sup>d</sup>
25:30:45	8.15±0.00 <sup>a</sup>	1.47±0.06 <sup>a</sup>	16.30±0.39 <sup>c</sup>	0.73±0.06 <sup>c</sup>	2.28±0.08 <sup>b</sup>	71.06±0.47 <sup>bc</sup>
25:45:30	8.40±0.07 <sup>b</sup>	2.12±0.05 <sup>b</sup>	18.04±0.92 <sup>c</sup>	0.82±0.05 <sup>d</sup>	2.34±0.0 <sup>bc</sup>	68.02±0.90 <sup>a</sup>
55:30:15	9.58±0.04 <sup>d</sup>	2.76±0.04 <sup>d</sup>	15.04±0.61 <sup>b</sup>	0.54±0.01 <sup>b</sup>	1.86±0.12 <sup>a</sup>	69.85±0.42 <sup>b</sup>

Values are means of duplicates determines ± SD values with superscripts on same column differ (p≤0.05) significantly. S- sorghum, M-mung beans, O-orange fleshed sweet potato



**Fig. 2. Bar chart of the tannin content of the weaning food formulations**  
Where S- sorghum, M-mung beans, O-orange fleshed sweet potato  
S:M:O-40:45:15(OLO), 40:30:30 (RUN), 25:35:45(KEM), 25:45:30(EVE), 55:30:15



**Fig. 3. Sensory score of weaning foods from blends of sorghum, mung beans and orange fleshed sweet potato**

Where S- sorghum, M-mung beans, O-orange fleshed sweet potato  
S:M:O-40:45:15(OLO), 40:30:30 (RUN), 25:35:45(KEM), 25:45:30(EVE), 55:30:15



**Table 3. Result of functional analysis of the blends weaning food**

S:M:O	Bulk density (g/cm <sup>3</sup> )	Swelling power (%)	Solubility index (%)	Water absorption capacity (g/gcm <sup>3</sup> )
40:45:15	0.61±0.00 <sup>b</sup>	4.64±0.14 <sup>a</sup>	12.00±2.83 <sup>a</sup>	1.58±0.14 <sup>a</sup>
40:30:30	0.65±0.00 <sup>c</sup>	6.01±0.95 <sup>ab</sup>	14.00±0.09 <sup>b</sup>	1.59±0.21 <sup>a</sup>
25:30:45	0.56±0.01 <sup>a</sup>	7.13±0.14 <sup>a</sup>	20.50±0.71 <sup>d</sup>	1.79±0.14 <sup>c</sup>
25:45:30	0.59±0.00 <sup>b</sup>	6.50±0.06 <sup>ab</sup>	16.50±2.12 <sup>c</sup>	1.68±0.04 <sup>b</sup>
55:30:15	0.55±0.00 <sup>a</sup>	4.94±1.20 <sup>a</sup>	12.00±1.41 <sup>b</sup>	1.61±0.11 <sup>a</sup>

Values are means of duplicates determines  $\pm$  SD values with superscripts on same column differ ( $p \leq 0.05$ ) significantly. S- Sorghum, M-mung beans, O-orange fleshed sweet potato

**Table 4. Result of pasting analysis of blends of the weaning food**

S:M:O	Peak viscosity (RVU)	Trough viscosity (RVU)	Final viscosity (RVU)	Break down (RVU)	Set back (RVU)	Peak time (min)	Pasting temperature (°C)
40:45:15	214 <sup>d</sup>	72 <sup>e</sup>	175 <sup>c</sup>	142 <sup>d</sup>	103 <sup>d</sup>	4.60 <sup>d</sup>	82.25 <sup>c</sup>
40:30:30	95 <sup>b</sup>	31 <sup>d</sup>	78 <sup>b</sup>	64 <sup>a</sup>	47 <sup>b</sup>	4.40 <sup>c</sup>	83.11 <sup>d</sup>
25:30:45	101 <sup>c</sup>	28 <sup>c</sup>	55 <sup>a</sup>	73 <sup>b</sup>	27 <sup>a</sup>	3.87 <sup>a</sup>	81.45 <sup>b</sup>
25:45:30	109 <sup>c</sup>	22 <sup>b</sup>	50 <sup>a</sup>	87 <sup>c</sup>	28 <sup>a</sup>	4.00 <sup>b</sup>	80.70 <sup>a</sup>
55:30:15	87 <sup>a</sup>	16 <sup>a</sup>	73 <sup>b</sup>	71 <sup>b</sup>	57 <sup>c</sup>	4.47 <sup>c</sup>	84.12 <sup>e</sup>

Values are means of duplicates determines  $\pm$  SD values with superscripts on same column differ ( $p \leq 0.05$ ) significantly. S- Sorghum, M-mung beans, O-orange fleshed sweet potato

#### 4. CONCLUSION

The study demonstrated that weaning food can be produced from blends of sorghum, mung beans and orange fleshed sweet potato with protein and carbohydrate content within the minimum threshold specified in Codex Alimentarius Standards for weaning food complementary food. The flour blends of S:M:O-25:45:30 was the best blend in terms of consumer acceptance of the weaning food while the most nutritious with good reconstitution properties was determined to be 25% sorghum, 30% mung beans and 45% sweet potato (S:M:O-25:30:45) blend.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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