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Research Article

Production and Evaluation of White Sorghum Based Weaning Food Blends and its Consumer Acceptability

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Received: February 05, 2020; **Published:** June 28, 2022

Abstract

Weaning is a gradual introduction of solid food into a baby's diet during the first year of life. During this crucial process, the baby will progress from breast milk or formula milk only to a fully mixed diet with foods of different textures and tastes. The aim of this study was to produce weaning food blends from white sorghum and pumpkin seeds. The samples were sourced from gamobru market, in Maiduguri, borno state, Nigeria, and were identified in University of Maiduguri, Biological Science Department. The samples were subjected to different processing methods The white sorghum was fermented to reduce the antinutritional factors, and also enhance the nutrient content, white the pumpkin seeds were toasted. The samples were assayed for proximate composition using standard Laboratory technique, while sensory evaluation was conducted for gruel prepared from the blends using standard methods. The result of the moisture content showed a significant ($P < 0.05$) difference, with blend 1 having the lowest moisture content of 4.10 ± 0.01%. However, the moisture content of the food blends was higher than the moisture content of the commercial weaning food (cerelac). There were significant ($P < 0.05$) differences in the total ash, protein, total fast and fiber content, while no significant ($P > 0.05$) difference was observed in the carbohydrate content of food blend 1 and the commercial weaning food blend. For the sensory evaluation, the general acceptability also showed that there was no blend that was generally rejected. It can thus be concluded that weaning food can be prepared using fermented white sorghum flour (WSF) and soya bean flour(SBF), and the prepared weaning food can be used a weaning food, the results of the proximate revealed that the food bleeds are nutrient dense, and can be used as a supplement for breastmilk during infancy stage.

Keywords: *White Sorghum; Weaning; Malnutrition*

Introduction

In Nigeria, numerous obstacles are impeded to achieve the good health of children. These include property, frequent natural disasters, poor sanitation and illiteracy. Children malnutrition and mortality rates in Nigeria are high, it is estimated that about 2.5 million Nigerian children are down with severe acute malnutrition [1] which is actually a huge number. It was noted that malnutrition has become a public health agency in Nigeria [1]. Children gain weight problem due to nutritional deficiency at their growth phase [2] and 56.6% of children are suffering from malnutrition [3].

Problem energy malnutrition (PEM) is a form of malnutrition and it increases risk of infection [4]. Malnourished children have severe breakouts of Diarrhea and higher risk of pneumonia than doing well-nourished children, this is a serious problem because any nutrient deficiency impairs the body's resistance to infection (Scrimsha and Sangiovanni, 1997).

In addition to mortality and morbidity childhood under-nutrition has long term effects on health, well-being and productivity [5]. Chronic under-nutrition is childhood impairs cognitive and physical development putting children at health risk for the remainder of their lives.

To prevent (PEM) during wearing, blundered flours such as sweet-potatoes and soybeans are common supplementary foods for malnourished children in some other African countries [6]. These blended flours are made from locally available, low cost ingredients, which are culturally and organoleptically acceptable by mothers and consumers in Africa countries [7]. Sensory testing of products from these blended flours has been done to establish product acceptability in different African countries like Nigeria and Ghana [8].

Weaning food is intended to bridge the wide gap between infant's breastfeeding and adult [9]. The term "to wean" means simply to accuse tom a baby, to food other than its mothers' milk. So weaning period is ultimately defined as the whole period during which breast milk is being replaced by other food which is very important. Additionally, commercial weaning foods are priced beyond the reach of the majority of the population in less developed countries. These foods are mostly manufactured using high technology and sold in sophisticated fancy packing [10]. Hence, these foods are too expensive for low income families, it is very difficult for them to provide their children with imported weaning food. Considering these entire problems an attempt has been taken to prepare weaning food from available sources, and to evaluate the nutritional composition and sensory attributes of the prepared to wean food from sweet potato and soybeans. In Nigeria children are found to be malnourished during the critical period of weaning and commercial weaning foods are mostly manufactured using high technology and sold in sophisticated packages which are too expensive for low income families, considering these problem an attempt has been made to prepare to wean food from available source.

Methodology

Sample collection

White sorghum pumpkin seeds were obtained from Gamboru Market in Maiduguri Borno state, Nigeria. The samples were identified in University of Maiduguri, Department of Biological Science, by botanist.

Preparation of food materials

Preparation of white sorghum

The grains were fermented as described by Kulkarni., *et al* (1991). About 500g of the white sorghum samples were soaked in a plastic bucket containing 300 ml of distilled water and steeped for one hour at room temperature (28 ± 2°C). The steeped water was discarded by decantation and the grains were fermented for 72 hours, after fermentation, the samples were sun dried for 2 - 3 days by putting it in a sterilized tray pan. The white sorghum grains were milled using a disc attrition mill (hunt No.2A Premier Mill hunt and Co, UK) to an average particle size of less than 0.3mm. The mill grain was then sieved through a fine mesh (5 mm) to obtain the wheat flour.

Preparation of pumpkin seed flour

The pumpkin seeds were sorted for dirt, defects and insects, washed with water and sundried to a constant weight and ground into a fine powder. The milled seeds were sieved through a 0.5 um mesh screen which gives the pumpkin seed flour.

Formulation of weaning foods

The formulation of weaning food was generally based on this assumption that the child consumes an average of 100g per day from this basis the formulation of weaning foods formulations was obtained using Pearson square method. were given in table 1. Then the prepared white sorghum-based weaning food blends were packed in polythene bag, sealed and store at room temperature.

Sample	Blends		Total
	WSF	PSF	
Cerelac®	-	-	100
Blend 1	70	30	100
Blend	60	40	100

Table 1: *Formulation of weaning food blends.*
Key: WSF: White Sorghum Flour; PSF: Pumpkin Seed Flour.

Proximate analysis

Proximate analysis was carried out according to standard method described by AOAC (2006) to determine the moisture content, ash content, crude protein, crude fibre, fat content, dry matter as well as carbohydrate composition of the blends. The respective methodology for each of the stated parameters is given below.

Determination of moisture content (Oven drying method)

Principle

This method is based on the loss of moisture on drying at an oven temperature of 105ºC. Besides water, the loss will include other matter volatile at 105ºC.

Procedure

A clean flat dish made of silica was dried in an oven and cooled in desiccators. The cooled dish was then being weighed (W1). Sample (5 grammes) was introduced and spread into the dish and weighed accurately (W2). The dish and its content were transferred into an air oven at 105ºC to dry for 3 hours using a pair of tongs. The dish was then transferred into a pipette and allowed to cool before weighing. The dish was returned to the oven for half an hour and again cooled in the desiccators and weighed. This process was repeated until a constant weight was attained (W3).

$$\text{Moisture Content} = \frac{(W2 - W3) \times 100}{(W2 - W1)}$$

Determination of ash content (Gravimetric method)

Principle

The organic component of food is burnt off in the oven. The residue is ash which consists of the inorganic components in the form of their oxides.

Procedure

A silica dish was cleaned, ignited, cooled (in a pipetted) and weighed (W1). Test substance (5 grams) labeled W2 was weighed accurately directly into the silica dish. Using a pair of tongs, the weighed samples were placed in a muffle furnace and the temperature was set 500ºC until fully turned ash (grey colour of ash). Upon ashing, the dish with the ash was removed from the furnace and kept in a desiccator to cool before weighing (W3).

$$\%\ \text{Ash} = \frac{(W3 - W1) \times 100}{(W2 - W1)}$$

Determination of fibre contents

Two grammes (2g) of the sample was weighed and transferred into 250 ml quick conical flask, 100ml of the digestion mixture was added and refluxed with occasional shaking for 45 minutes. The mixture was filtered through ashless filter paper using gentle suction. This was washed with 100 ml of boiling water and 50 ml of alcohol followed by 50 ml of petroleum ether. The filter paper with the sample was dried at 100°C to constant weight. The filter paper was weighed to obtain the weight of the residue. The residue was then put in a crucible which was already weighed and turned ash at 600°C in a muffle furnace for 4 hours. The crucible was then removed and placed in a desiccator to cool after which it was weighed again. The percentage of crude fiber was calculated using the relation below:

$$\% \text{ of crude fibre} = \frac{\text{C-F X 100}}{2g}$$

Where

b = Weight of paper +residue

a = Weight of paper alone

C=b-a = Weight of residue

e = Weight of dish + ash

d = Weight of dish alone

f=e-d = Weight of ash

C-f = Weight of crude fibre

Determination of fat content (Soxhlet extraction method)

Principles

Gravimetric estimation of fat from a dry powdered solid after a continuous extraction with light organic solvent (Petroleum ether, 40 - 60°C).

Procedure

Five grammes (5g) of the samples were accurately weighed (W) using a weighing dish. The flat bottom flask was weighed (W1) before the extractor was mounted on it. The thimble was held half way into the extractor and the weighed sample was carefully transferred into the thimble. The weighing dish was rinsed with petroleum ether and poured into the thimble. The thimble was plugged with cotton wool and dropped fully into the extractor. The solvent was thereafter poured to reach about two thirds of the volumes of the flask and continuous extraction has taken place for five hours. When extraction is completed, the solvent was evaporated on water bath at 60°C followed by drying of the residue. The flask and residue was cooled and weighed (W2).

$$\% \text{ Fat} = \frac{(W2 - W1) \times 100}{W}$$

Determination of protein content (Kjeldahl method)

Principle

This method will not include nitrogen from nitrites and nitrates but will include nitrogen from protein, alkaloid, nucleic acids, etc. The organic matter is oxidized by concentrated Sulphuric acid in the presence of catalyst and the Nitrogen converted to Ammonium Sulphate.

Protein determination involves three major stages; they include:

- Digestion

- Distillation
- Titration

Digestion of sample

Two grams (2g) of sample was weighed into a digesting tube (Kjedahl digestion tubes) and twenty mills (20 ml) of sulphuric acid were added. The digester was connected and allowed to run for 3 hours. Fifty mills (50 ml) of 40 % NaOH was added, and the volume was made up to 100 ml using distilled water.

Distillation

Five milliliters (5 mls) of Borate (2%) was introduced into a conical flask and 3 drops of bromocresol and methylene indicator was added into the conical flask. Five milliliters of digested sample were introduced into the distillation flask through the funnel and twenty (20 mls) of 40% NaOH was also added into the distillation flask. All the inlets were closed. The conical flask containing the borate and mixed indicators was placed at the extended tube (outlet) of the distillate unit and seventy-five (75 mls) of the distillation was collected into the conical flask. This is to be titrated with the standard 1M HCl.

Standardization of HCl

Five milliliters (5 mls) of ammonium solution will be pipetted and distilled with about fifteen milliliters (15 mls) of 40% NaOH solution. The liberated ammonia will be collected in a conical flask containing five milliliters (5 mls) of 2% boric acid and 4 drops of mixed indicator. The ammonia solution will be titrated with the standard 0.1m HCl. The amount of HCl required for the titration will be the acid factor that will be used in the calculations of crude protein content.

The percentage protein will be calculated using the formula:

$$\% \text{ protein} = \frac{A \text{ X } N \text{ X } F \text{ X } 14.007}{\text{Weight of sample x aliquot taken}}$$

Where: A = Volume of the acid used

N = Molarity of the acid

F = Factor 6.25

Determination of carbohydrate content (By difference)

The carbohydrate contents were determined by differences obtained after the subtraction of total crude protein, fat, ash and crude fibre from the total dry matter.

% of carbohydrate = 100 - (% Moisture + % protein + % fat + % ash + % crude fibre)

Determination total energy content (Formular method)

The total energy values were determined according to the method of Mahgoub (1999) using the formula:

Total energy (Kcal/100g = (% available carbohydrate x 4) (% protein x 4 + (% fat x 9).

Sensory evaluation

Sensory evaluation was conducted for each of the formulations. A total of 10 panelists, w participated in this study. Samples were evaluated in a soundproof, humidity-controlled sensory room. A total of three replications were completed. High protein diet food samples were placed in 20 ml white plastic cups with lids. All cups were coded with three-digit random numbers, served at room temperature and the order of serving for each judge was randomized. Panelists were instructed to remove the lid and reconstitute the samples with warm water (50°C) to 20 % total solids concentration. The judges evaluated the samples for color, appearance, flavor, odor, texture and overall acceptance on a 9-point scale ranging from like extremely (9) to dislike extremely (1).

Result

The table 2 below shows the result for the proximate analysis of weaning food prepared from white sorghum potato and soybeans and commercial weaning food (cerelac). The result of the moisture content showed a significant ($P < 0.05$) difference, with blend 1 having the lowest moisture content of 4.10 ± 0.01%. However, the moisture content of the food blends was higher than the moisture content of the commercial weaning food (cerelac). There were significant ($P < 0.05$) difference in the total ash, protein, total fast and fibre content, while no significant ($P > 0.05$) difference was observed in the carbohydrate content of food blend 1 and the commercial weaning food blend.

Sample	Blend 1	Blend 2	Cerelac®
Moisture (%)	5.34 ± 0.02^a	4.10 ± 0.01^b	2.06 ± 0.01^c
Ash (%)	2.93 ± 0.01^a	3.98 ± 0.02^b	3.58 ± 0.02^c
Protein (%)	18.01 ± 0.02^a	19.61 ± 0.01^b	16.89 ± 0.01^c
Fat (%)	7.61 ± 0.01^a	5.11 ± 0.02^b	5.42 ± 0.01^c
Fibre (%)	3.75 ± 0.03^a	4.73 ± 0.01^b	3.29 ± 0.02^c
Carbohydrate (%)	62.39 ± 0.21^a	55.47 ± 0.13^b	68.76 ± 0.02^c
Total Energy. k/cal/100g	390.09 ± 0.21^a	346.31 ± 0.31^b	391.38 ± 0.23^a

***Table 2**: Proximate composition of food blends.*

Key: Blend 1 = 70% white sorghum: 30% pumpkin seeds; Blend 2 = 60% white sorghum: 40% pumpkin seeds.

Sensory evaluation

Table 3 showed the results of organoleptic assessment for the different food blends. And commercial food blend. The result of rating for taste as shown in the table ranged from (47.05 - 89.0) for the blends. The food blends 1 - 2 had a value of 7.05 and 7.30 respectively, while the commercial food blend (Cerelac) had 90. The differences were significant ($P < 0.05$). The odour rating ranged 6.40 - 7.05 for the blends. The commercial blend (Cerelec®) recorded highest value of 8.75. The result of the colour rating also ranged from (7.45 - 8.98). The food blend 1had the highest value, but lower than the commercial control blends. There were no significant ($P > 0.05$) difference in the texture and overall acceptability rating of food blends 1 and 2, the higher values for the texture and overall acceptability was observed in the commercial control.

	Taste	Flavour	Colour	Texture	Overall Acceptability
Blend 1	7.30 ± 0.13^a	7.05 ± 0.17^a	7.90 ± 0.19^a	7.85 ± 0.20^a	7.45 ± 0.17^a
Blend 2	7.05 ± 0.15^a	6.40 ± 0.22^b	7.45 ± 0.20^a	7.80 ± 0.21^a	7.30 ± 0.24^a
Cerelac®	9.0 ± 0.13^b	8.75 ± 0.01^c	8.98 ± 0.02^b	8.85 ± 0.12^b	9.00 ± 0.02^b

***Table 3:** Sensory evaluation of food blends.*

Discussion

Proximate composition

The low moisture contents observed in the food blends and the commercial weaning food is a good indicator of their potential to have longer shelf life. This is in accordance with the findings of Adebayo-Oyetora., *et al.* [11] and Laminu., *et al* [12]. The low moisture content of food products inhibits biochemical activities of invading microorganisms and therefore, prevents food spoilage during storage [13].

The protein content of the food blends was higher than that of the commercial control blend and met the recommended daily Allowance (RDA) of infants of 0 - 1 year. The blending of two or more cereal and legumes with fish meal complement each other is a key feature of food. The high protein contents of these blends are as a result of blending with high proportion of soya bean. According to FOA/WHO [14] Codex Alimentarius standard for food blends, the protein contents of food blend should range from 14.52 - 37.70 g/100g for maximum complementation. In this research, the protein content of the food blends was above the FAO/WHO limits. Thus, the formulations can be used as an alternative for the management of protein-energy malnutrition.

The fat contents of the food blends correspond to the recommended fat levels for malnourished which should be less than 10%. The fat contents of a food can affect its shelf life stability. This is because fat can undergo oxidative deterioration, which leads to food spoilage. Hence, the food blend with a high fat content is more liable to spoilage than one with o lower fat content. High dietary fibre contents have been reported to impair protein and mineral digestion and absorption in human nutrition. Hence, low fibre blend are suitable for the management of kwashiorkor which requires adequate intake of protein and mineral. All the food blends exhibit low fibre contents.

The carbohydrate contents of the food blends and the commercial control blend were lower than the lower limit for carbohydrates (41.3 - 73.79 g/100g) of the Codex Alimentarius standard. For all the food blends, both prepared and the commercial, the energy density per 100g of the dry food was lower than the maximum energy (483.9 kcal/100g) recommended in the Codex Alimentarius standard for weaning foods.

Sensory evaluation

The mean scores for taste of food blends 1 and 2 were generally acceptable. However, in comparison with the commercial weaning food blends, the commercial blends were prepared more The best score rating of the control diet would be as a result of flavouring addition in the product. Children especially the malnourished are likely to reject unflavoured foods. Therefore, to further improve the taste ratings, flavor enhancer might need to be incorporated into the formulated samples.

The sample rating score for flavour showed that the blends were also generally acceptable. Generally, the mean scores for colour of all the food blends were accepted showing that judged by this sensory evaluation. The texture rating also showed that the food blends were highly accepted. The texture is very important, as it would determine the amount of food an infant would consume, because infant can only swallow a smooth gruel and not a coarse product. Formulations with a considerable amount of ground fish were list judged by this sensory attribute.

The results for overall acceptability attained by Oyarekua [15] from diet obtained from co-fermented maize, sorghum and cowpea were higher than those obtained in this study ranging from 5.8 - 8.5. The factors affecting the general acceptability are the taste, flavour, colour and texture, of the diets. The higher general acceptability rating of control diet could be attributed to additional flavourings, colouring and sophisticated processing of raw materials. The general acceptability also showed that there was no blend that was generally rejected [16-26].

Conclusion

In Nigeria, the weaning foods are important to overcome the problem of malnutrition of infants and babies during weaning periods. But these foods are too expensive for low income people. So, it is important to prepare weaning food from locally available raw materials because commercial weaning food is gradually getting out of reach of these families. Developing a technology to prepare weaning food from low-cost materials drawn lots of attention now in the country. From this research work, it can thus be concluded that weaning food can be prepared using fermented white sorghum flour (WSF) and soya bean flour (SBF), and the prepared weaning food can be used a weaning food, the results of the proximate revealed that the food bleeds are nutrient dense, and can be uses as a supplement for breastmilk during infancy stage.

Recommendation

The result obtained indicates that the prepared food from white sorghum and pumpkin seeds is rich in protein content and even higher than that of the commercial weaning food blend (Cerelec®). The analysis also shows that the food is nutritious. Therefore, the food should be recommended for infants as an alternative to the high cost commercial weaning food blends.

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