The Pharma Innovation Journal 2022; 11(7): 01-07

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5. 23
TPI 2022; 11(7): 01-07

www.thepharmajournal.com
Received: 01-05-2022
Accepted: 03-06-2022

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Chemical analysis of complementary food produced from blends of *Pennisetum glaucum, Vigna subterranean Telfairia occidentalis and Solanum melongena leaf*

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Abstract

The period of weaning of a child is very important, as an infant is transfer from the mother's breast milk that is nutritious and uncontaminated to the regular diets that the family members eat with chance of vulnerable to malnutrition and disease. During this period of infancy, which is between 6 and 24 months, the transition is usually from semi-solid to a more solid diet. The rate of mortality and morbidity among infants during this stage is on the increase as a result of malnutrition. Available research statistics have shown that infant formula rich in protein, minerals and vitamins are in short supply in most part of the world including Nigeria particularly in the rural areas. Although there are potential raw materials that could supply enough protein, mineral and vitamins for the growing infants. Beside this, the availability and consumption of commercial infant formula are very cost expensive and less available throughout the country. In order to reduce these problems, producing infant formula from locally available low priced food items, nutritious, acceptable is recommendable.

Efforts are being made to improve the nutritional status of infants by producing highly nutritious, cheaper and available complementary foods from locally available ingredients hence the blending of *Pennisetum glaucum* flour, *Vigna subterranean* flour and *Telfaria occidentalis* leaf powder or *Solanum melongena* leaf powder in different ratio was carried out to produce various weaning diets using newly weaned 36 albino rats in the animal studies trial. The proximate analysis of these ingredients were carried out using acceptable standard methods. Crude protein content ranged from 12.44±0.01% to 32.50±0.03%,Crude fibre ranged from 1.85±0.02% to 4.35±0.04%,Ash content from1.81±0.02% to 8.11±0.02%,Oil content ranged from 1.88±0.01% to 8.06±0.01%,moisture content from 7.42±0.03% to 86.12±0.03% and carbohydrate from 54.56±4.10% to 78.36±0.08%.The ingredients were blended and fortified in the ratio of 50:30:20 to produce complementary weaning foods (MIBFP and MIBGE diets) respectively. While the unfortified weaning food(FCW diet)served as control) The proximate composition of the formulated diets MIBFP, MIBGE diets and FCW control diet, indicated the crude protein content had 20.90±0.32%, 17.17±0.03% and 24.95±0.21%respectively,crude fibre content had 20.25±0.22%,16.88±0.07% and 5.067±0.10% respectively. Ash content 4.56±0.02%, 4.86±0.02% and 5.00±0.02%, while Moisture content had 6.067±0.28%, 6.66±0.04% and 29.86±0.02%. The carbohydrate content being 45.22±0.09%, 50.74±0.07% and 34.70±0.49% respectively. Animals studies using newly weaned rats were carried out for a period of 28 days and results recorded properly and analyzed after sacrificing the animals.The result of this research indicates that *Pennisetum glaucum* flour, *Vigna subterranean* flour and *Telfaria occidentalis* leaf powder or *Solanum melongena* leaf powder, if properly harnessed, processed and blended could give infant formulae that are nutritionally rich, locally available as well as cheaper for low income weaning mothers especially in the developing nations.

Keywords: Weaning, Formulation, Infant, *Pennisetum glaucum, Vigna subterranean*, *Telfairia occidentalis and Solanum melongena*, blending

Introduction

The growth of the infant in the first or second years is very rapid and breast milk alone cannot meet the child's nutritional requirements. The infant needs supplementary feeding especially during the weaning stage which starts from six months and above (Unegbu *et al*. 2021; Ijarotimi and Famurewa, 2006) [51, 25]. Lack of food, improper infant and child feeding practices critically affects child growth, development and survival coupled with high rates of infections during the first two years of life (IFPRI, 2005). Protein –energy malnutrition is a major nutritional deficiency condition that often occurs during the critical transitional phase of weaning in infants, crippling their physical and mental growth (Unegbu *et al.* 2021, Oluseye *et al.* 2009, Katiforis *et al.* 2021) [51, 40, 29].

Available research statistics have shown that infant formula rich in protein, minerals and vitamins are in short supply in most part of the world including Nigeria particularly in the rural areas. Although there are potential raw materials that could supply enough protein, mineral and vitamins for the growing infants (Ijarotimi and Famurewa, 2006) [25]. Beside this, the availability and consumption of commercial infant formula are very less available throughout the country which accounted for 1.78% (CSA, 2011). In order to reduce these problems, producing infant formula from locally available low priced food items, nutritious and acceptable is recommendable (Yewelesew *et al*. 2006, Temesgen, 2013, Dewey and Brown, 2003) [54, 49].

Recent studies have shown that Leafy vegetables such as *Telferia occidentalis*, *Solanum melongena* are rich in minerals such iron, potassium sodium, calcium and vitamins such as riboflavin, ascorbic acid, thiamine and other antioxidant properties which are of high benefit to the infant and adult's body (Longe *et al*, 1983; Oboh *et al*, 2006, Okochi and Okpuzor, 2005) [32, 38, 39]. Most cereals and legumes often use for weaning food preparation are limited in essential amino acids (eg lysine and methionine)and are usually corrected by complementation (Longe *et al*. 1983) [32].

Many efforts to improve the health and nutritional status of infants and growing children have focused primarily on the production of highly nutritious, low-cost complementary foods, which are culturally acceptable (UNICEF? 2006) [52]. Several studies have reported that most of the weaning foods consumed by children in many parts of developing nations are deficient in essential macro and micro nutrients (Brabin and Coulter, 2003; Milward and Jackson, 2004) [9, 34]. The family diets to which some infants are weaned are also low in nutritional value. Indeed, many investigators (Rachael *et al.* 2021) have reported that these traditional foods are low in protein and other nutrients. Food fortification involves the inclusion of micronutrients and vitamins that are not initially present or present in diminutive quantity within the foods, whereas food enrichment involves the addition of nutrients (macro or micro alike) to foods to compensate for losses that may have occurred during processing. Fortification, blending and enrichment of foods low in certain nutrients improve the nutritional status of developing countries where the cost of buying foods rich in animal protein is unaffordable (Bolarinwa *et al.* 2019) [8]. In view of this nutritional problem, several strategies have been used to formulate weaning food (Lalude and Fashakin, 2006. Ijarotimi and Ashipa, 2006; Ijarotimi and Bakare, 2006) [30, 24, 26] through combination of locally available under-utilized food crops that complement each other and this research has proved to be part of the remedies to infants malnutrition and diseases associated with it.

Materials and Methods

List of materials used in the studies

All chemicals used in this research work were of analytical grade. *Pennisetum glaucum* grains, *Vigna subterranean* seeds, *Telfaria occidentalis* leaf, *Solanum melongena* leaf, Albino rats, Whatman filter paper, conical flask, test tubes, weighing machine, blender, Alumium foil, Feed troughs, Drinkers, Refrigerator machine, Spectrophotometer, Pipette, Volumetric flask, Separating funnel, muffle furnace, Porcelain crucible, Extraction flask, Cotton wool, Oven, Flame photometer, Thimble, Granding machine, Extractor, Desicator, Boiling Flask, Metabolic cages, Soxhlet extractor, Centrifuge machine, Computer, Knife, Scissors, traypan, Buckets, Siever among others.

Source of samples and Collection: Fresh edible *Telferia occidentalis* leaf and *Solanum melongena* leaf were harvested from Homestead, Horticulture section of National Root Crops Research Institute Umudike and Forestry Research Institute of Agriculture, Ahiaeke all in Abia State, Nigeria. The plants were identified at the Department of Botany. *Pennisetum glaucum* grains were purchased from the Grains section of National Root Crops Research Institute. *Vigna subterranean* Bean seeds were purchased at a market called Orieugba in Umuahia. A brand of commercial weaning (Nutrition and Nourishment (NAN) nestle milk) food was purchased from a supermarket at Umuahia.

Preparations and Processing of Ingredients Sample

The legumes and cereals were prepared using the method described by Solomon (2005) [48]. The dirts, stones, and other foreign materials were discarded from the samples. They were air-dried for 4 days to a constant weight. The cereals were soaked in tap water for 12 hours and washed, air-dried for 3 days separately milled and sieved in a laboratory to get the powder form. The milled flour samples were packaged and stored in containers until use. The legumes were soaked in tap water for 12 hours and washed then air-dried for 4 days (Solomon (2005) [48]. Soaking was intended to remove the beany flavor). The cereals were separately milled in a disc attrition Grinding mill and sieved with standard sieve (500 Um). The leaves powder was prepared using a method described by Gernah and Sengev (2011) [17]. The dirts, stones, and other foreign materials were discarded from the samples. The leaves were washed and air-dried indoors at room temperature for 2 days (to a constant weight and the leaves were milled into powder and sieved with a fine sieve (500 Um) a laboratory electric blender to obtain powder form and was then dried to constant weight in air. The powder form were packaged in black polythene bags and stored in air tight plastic containers away from light.

Table 1: Processing of Ingredients

Leaf Vegetables	Cereals	Legumes
Solanum Melongena& Telfairia occidentalis	*Pennisetum glaucum*	*Vigna subterranean*
Sorted & discarded of dirts and foreign materials	Sorted	Sorted
Washed with clean tap water	Washed with clean tap water	Washed with clean tap water
Air-dried for 3 days	Steeped for 12 hours and Sun dried for 4 days	Steeped for 12 hours and Sun dried for 4 days
Weighed &	Dry milled	Dry milled
Milled and		
Sieved into powdered	Sieved into flour	Sieved into flour
Packaged	Packaged	Packaged

Diets Formulation and Fortification
The ingredients used for the formulations were processed separately into powdery flour form. The samples were formulated by combining them in different proportions. *Pennisetum glaucum* flour, *Vigna subterranean* flour were blended and fortified with *Telferia occidentalis* or *solanum melongena* in the ratios of 50:30:20 all in 100g each and the Treatments 1,2 were appropriately formulated. The Commercial weaning food (FCW) was the control diet and the formulated diets are MiBFp and MiBGe. The ratio was arrived at based on their protein content through material balancing (Smith, 2003) to give protein food as recommended by the protein advisory group (PAG,1971) for infant diets, as described by Solomon(2005) [48]. The blends were mixed thoroughly using a Phillips blender.

MiBFp diet
This diet was formulated with 50% *Pennisetum glaucum* flour, 30% *Vigna subterranean* Bean flour and 20% *Telfairia occidentalis* leaf powder.

MiBGe diet
This dietwas formulated with 50% *Pennisetum glaucum* flour, 30% *Vigna subterranean* bean flour, and 20% *Solanum melongena* leaf powder.

Housing, Handling and Feeding of the Animals with the formulated diets
Animal feeding trial was conducted in compliance with the guidelines for ethical conduct in the care and use of non human animals in research (APA, 2010).

A total of 36 newly weaned albino rats were used in the trial. The feeding trials were carried out with albino rats using the methods described by (Gernah *et al.* 2012, Makkar and Becker 1999, Aregheore *et al.* 2003) [18, 33, 6]. The male albino rats were purchased from animal breeders from Awka in Anambra state and from Michael Okpara university of Agriculture Umudike. The rats were transported to Michael Okpara university of Agriculture Umudike in a stainless aluminum cage. The rats were housed in the Animal House of the college of Animal Science, Michael Okpara University of Agriculture, Umudike in a standard steel metabolic cages and acclimatized for 5 days under tropical condition. The animals were exposed to 12 hours light /dark cycle and were given Vita Feed growers mesh and clean tap water ad-libitum. After acclimatization for 5 days, the animals were weighed, sorted and divided into three groups (Aregheore *et al.*, 2003) [6]. Each group contain 4 animals and in triplicate for each group, giving 12 animals for each group diet. Under humid tropical conditions, they were fed ad-libitum and had free access to feed and water with feed troughs and drinkers throughout the period of 28 days and the faecal and urine samples were collected in the course of the trial and stored in refrigerator for analysis after the feeding trial. A mean weight difference of ±3g was maintained inter group (Onyeike and Osuji, 2003) [42].

Animal sacrifice
After 28 days feeding trial, the animals were fasted overnight and sacrificed by cardiac puncture using materials like Dissecting set, Dissecting board Gloves, Cotton wool, Normal saline, Syringes (5ml), Dazing stick and Pre-weighed papers for organ weight.

Chemical Analysis
The proximate Analysis were carried out with standard methods. Crude Protein was evaluated using Kjedhal method as described by Onwuka (2005) [41]. The principle involves the use of concentrated tetraoxosulphate (VI) acid (H2SO4, an oxidizing agent). In the presence of a suitable catalyst such as copper, titanium, selenium or mercury used to digest the sample and the nitrogen from the protein and other constituents of the sample was converted to ammonium tetraoxosulphate (VI, (NH4) 2SO4. The Moisture content was carried using the Vacuum Oven drying Method (VOM) (AOAC, 1984, Onwuka, 2005) [4, 41]. The ash content was determined by the method described by Onwuka, 2005) [41]. The organic matter in food was burnt off and the inorganic material left is cooled and weighed. This was then heated gently to expel moisture and heated strongly to cause the charring of the sample followed by a much stronger heat treatment (560-600) in a muffle furnace to reduce the sample to ash (Onwuka, (2005) [41]. The crude fiber which is suspected to contain more than 1% fat is first rendered fat-free by treatment with petroleum ether. The defatted sample was treated with boiling H2SO4 and later with boiling NaOH, and the residue left after subtraction of the ash is taken as the fiber Onwuka, (2005) [41]. The carbohydrate content was calculated by difference as the a method separately developed by (Pearson, 1976) as described by Onwuka, (2005) [41]. In this method carbohydrate content was obtained by calculation having estimated all the other fractions by proximate analysis. Nitrogen free extract (NFE) content was calculated by difference as the method separately developed by (Pearson, 1976, Onwuka, (2005) [41].

Biological Assay Determination
Biological Assay determination carried out, which include calculation of the nutritional parameters such as FCR, PER, NPV. TDN.

Protein Efficiency Ratio (PER)
Protein Efficiency Ratio was determined by the method described by Sarwar and Peace (1994).

Protein Efficiency Ratio is based on the weight gain or loss of a test subject divided by its intake of a protein in food during the test period (Obimba *et al.*, 2018, Onyeike *et al.*, 2003) [37, 42].

Feed Conversion Ratio (FCR)
The total weight of feed is divided by the net production. Feed conversion Ratio = Feed Intake /Weight Gain **(**Onyeike *et al.*, 2003, Obimba *et al.*, 2018) [37, 42].

Net Protein Value (NPV)
This was calculated from the digestibility utilization and the biological value. NPV= Biological Value x Digestion coefficient (Onyeike *et al.*, 2003) [42].

Absorbed Nitrogen
The quantity or amount of Nitrogen assimilated by the animal during feed trial. And Absorbed Nitrogen is calculated = Nitrogen Intake- Faecal Nitrogen **(**Onyeike *et al.*, 2003) [42].

Biological value (BV) Determination
Th**e** proportion of the digested (and absorbed) protein that is not excreted in the urine. BV=N intake – (faecalN+urinary N

X 100/N intake faecal N (Onyeike *et al.*, 2003) [42].

Total Digestible Nutrient (TDN.

% TDN= Dig. prot. %+Dig. Fibre%+Dig. NFE%+ (Dig. Ether Extract % X 2. 25) (Onyeike *et al.*, 2003) [42].

Analysis of Data

For statistical analysis, data generated from the results of the studies were statistically analyzed. The data were subjected to statistical analysis of variance (ANOVA) and separation of means was done by Turkey; s Test multiple comparison post hoc tests to compare the level of significance between control and experimental groups. The values of $p< 0.05$ were considered as significant (Ihekoronye and Ngoddy, 1985).

Results and Discussion

Composition of Ingredients for formulation of diet and Proximate Analysis

Table 2: Percentage Composition of the Ingredients used in the formulation of the Experimental Diets.

Ingredients Scientific Name	Ingredients Common Name	MIBFP Diet	MIBGE diet	FCW diet (control) (Nestle NAN)
Pennisetum glaucum	Millet	50	50	--
Vigna subterranean	Okpa	30	30	--
Telfairia occidentalis	Fruited Pumpkin leaf	20	----	---
Solanum melongena	Garden Egg leaf		20	---
Total		100g	100g	100g

The table shows the percentage composition of the different ingredients used for the blending and fortification of the weaning food, the scientific names, common names and the control diet which is Nestle NAN.

Table 3: Proximate Composition of the Formulated Diets Used For The Feeding Trial

Parameters	MIBFP	MIBGE	FCW
%Crude Protein	20. 90±0. 32	17. 17±0. 20	24. 95±0. 21
%ASH	4. 56±0. 02	4. 86±0. 20	5. 00±0. 023
%Moisture	6. 07±0. 22	6. 66±0. 36	29. 86±0. 02
%Fibre	20. 25±0. 22	16. 88±0. 07	5. 067±0. 10
%Ether	3. 00±0. 00	3. 69±0. 04	0. 60±0. 00
%NFE	60. 11±0. 34	63. 17±0. 17	31. 31±0. 02
% CHO	45. 22±2. 00	50. 97±0. 07	34. 29±0. 49

The Nutrient Composition of the blends of *Pennisetum glaucum, Vigna subterranean (MIBFP) and Telfairia occidentalis and Pennisetum glaucum, Vigna subterranean* and *Solanum melongena* (MIBGE) diets are compared with the control Infant Food (FCW) as shown in the table values are mean±standard Deviation of Triplicate Determinations.

Table 4: Comparison of the Feed Conversion Ratio (FCR), Protein Efficiency Ratio (PER), Biological Value (BV), Absolved Nitrogen, Nitrogen Protein Value (NPV), Total Digestible Nutrient (TDN) of the Diet groups with the control diet group quality values of the formulated and fortified diets with the Control diet.

Parameter	MIBFP	MIBGE	FCW
FCR	45. 30±0. 83	48. 60±1. 90	34. 90±1. 10
PER	0. 10±0. 10	0. 12±0. 05	0. 19±0. 10
BV	98. 10±0. 05	98. 70±0. 22	94. 9±0. 67
Absolved Nitrogen	3. 33±0. 22	2. 60±0. 02	2. 22±0. 05
NPV	9318. 52±32. 38	9385. 41±1. 78	8792. 08±60. 95
TDN	48. 26±0. 59	39. 17±0. 17	44. 68±0. 30

The Table 4 shows the Result of the comparison of the Feed Conversion Ratio, Protein Efficiency Ratio, Biological Value, Absolved Nitrogen, Net Protein Value, Total Digestible Nutrient of the Diet groups with the Control group values are Mean± Standard Deviations of the Triplicate Determination

Table 5: Initial, Final, and Mean Weight Gained By the Animals Over The 28 Days Experimental Period.

Parameter	MIBFP	MIBGE	FCW (Control)
No of Animals	4 (Triplicate)	4 (Triplicate)	4 (Triplicate)
Initial Weight (g)	62. 50	67. 50	60. 50
	60. 80	67. 90	58. 90
	61. 80	67. 10	60. 10
Final Weight (g)	102. 80	104. 50	114. 10
	102. 20	102. 00	112. 50
	101. 80	101. 90	110. 90
Weight Gained(g)	40. 30	37. 00	53. 60
	41. 40	34. 10	51. 60
	40. 00	34. 80	50. 80
Mean Weight Gained (g)	40. 57	35. 30	52. 00

The table 5 shows the Initial, Final, and Mean Weight Gained by the Animals over the 28 Days Experimental Period with the control diet results and Mean± Standard Deviations of the Triplicate Determination.

Discussions

Table 2 shows the compositions of the ingredients used in the formulation of the different diets in the ratio of 50:30:20, before the blending and fortification of MIBFP and MIBGE diets. The same quantity of the control diet is used in the food studies. This is to ensure that the quantity of diet given, the diet intake and the left over were calculated.

Table 4, shows the proximate composition of the formulated diets (MIBFP and MIBGE) with the control diet FCW. The MIBFP diet had the highest crude protein of 20. 90±0. 32% when compared with MIBGE diet which has 17. 17±0. 20%, when compared with the control diet with 24. 95±0. 21% that is significantly different ($P< 5$) from the formulated diets. The

ASH content of MIBGE diet is (4. 86±0. 20% higher than MIBFP diet, but decrease significantly (p>0. 05) from the control diet which had 5. 00±0. 02%.

The percentage moisture of MIBGE diet which 4. 86±0. 20% is higher than MIBFP diet with 6. 07±0. 02%, but the control diet had a very high moisture content of 29. 86±0. 02%. However the crude fibre content of MIBFp diet had the highest with 20. 25±0. 22% significantly different from the MIBGE diet 16. 88±0. 07% and the control diet 5. 067±0. 10% respectively. The percentage Ether content is highest in MIBGE diet with 3. 69±0. 036%, while MIBFP diet had 3. 00±0. 00% significantly higher (p< 0. 05) than the control diet that had 0. 60±0. 00%. The crude fibre content is highest in MIBFP with 20. 25±0. 22% but higher than MIBGE diet with 16. 88±0. 07%and significantly increase (p< 0. 05) than the control diet with 5. 06±0. 10%. The MIBGE diet has the highest percentage NFE of 63. 17±0. 17% significantly increase (p< 0. 05) than MIBFP diet with 60. 11±0. 34% and the control diet that had 31. 31±0. 02% and in the carbohydrate content MIBGE diet with 50. 74±0. 07% is significantly increased (p< 0. 05) than MIBFP with 45. 223±0. 09% and control diet with 34. 70±0. 049% respectively.

The result of the proximate composition of the two diets, though varies with the control diet in few areas but compared favorably well with the control diet, indicating that they can be used in place of the control diet. Protein is an essential element for the development and growth of an infant. Protein contains different amino acids that are linked and provide both calories and amino acid building blocks that are necessary for proper growth and are recommended that infants should consume about 16g of protein daily (Unegbu *et al.*, 2021, Muller, 1988) [51]. The protein in human will Provides between 10% -15% of infants daily caloric need, hence the consumption of adequately quality protein is needed to remedy protein –energy malnutrition which is a major nutritional deficiency condition that often occurs during the critical transitional phase of weaning in infants. The Protein content will provide the baby with immunoglobulins, a type of protein that provide infection fighting immunity Healthy infants generally thrive on weaning foods that contain high protein content (AAP, 2002, Creed-Kanashira, 1999).

The crude fibre content of the diets are higher, indicating that they are good for infants too. Although, crude fibre does not contribute nutrients to the body, but it adds bulk to food and facilitating bowel movements (Peristalsis) as well as preventing many gastrointestinal disease (Gordon, 1999, Unegbu *et al.*, 2021) [51].

The moisture content is lowin the two diets when compared with the control diet. High contents of moisture is indication of water content and water is an important part of an infant's diet because water makes up a large proportion of the baby's body, therefore the low moisture content in the formulated diet could be as a result of processes involved in the preparation of the ingredients for the formation and blending which include drying process. When properly prepared most infants formulae are approximately 85% water (Heird *et al.*, 2011, Hoppe *et al.*, 2013) [22]. However, failing to adequately dilute the weaning food concentrate with water causes weaning foods to be too concentrated or hypertonic and hypertonic weaning foods can induce diarrhea and dehydrating (Unegbu *et al.*, 2021, AAP, 2002, Ijeh *et al.*, 2004, Hallberg and Hulthen, 2000) [51, 27, 20].

The increase in ASH content in the diets is an indication of increase in mineral content minerals and vitamins are vital to the functioning of many body processes. They are critical players in nervous system functioning other cellular process, water balance and structural systems (Darby, 1976, Obimba *et al.*, 2016) [13, 37]. The presence of mineral elements in infant nutrition is vital for the metabolic process. They have important roles to play in many activities in the body (Okpochi and Okpuzor, 2005) [39]. Every form of living matter requires these inorganic elements for their normal life process (Ozcan, 2003) [43]. The carbohydrate content in the diets are moderate and good for the baby. Carbohydrates are an important sources of energy for growing infants as they account for 35% to 42% of daily energy intake. It is important for the brain tissues, muscles and other organs functioning (Schman Labula, 2000). Lactose is the major carbohydrate in human in human breast milk, cow milk and in most milk – based Infants formulas, while most Infants will thrive on a formula that contains lactose, some Infants are lactose – intolerant (Heird *et al.*, 2011).

Table 5: shows the comparison of the Feed conversion Ratio (FCR), Protein Efficiency Ratio (PER), Biological Value (BV), Allowed Nitrogen, Net. Protein Value (NPV), Total Digestible Nutrient (TDN) of the diet groups with the control diet. The Feed Conversion Ratio of MIBGE diet had 48. 6±1. 9g improved significantly (p< 0. 05) than MIBFP diet (45. 3±0. 83g) and the control diet (34. 90±1. 1g). The control diet (FCW diet) had the highest protein Efficiency Ratio of 0. 19±0. 01 than the MIBFP and MIBGE diets with (0. 10±0. 10g and 0. 12±0. 05g), while MIBGE diet had the highest in biological value 98. 7±0. 22g significantly increased (p< 0. 05) than MIBFP with 98. 10±0. 05g and control diet with 94. 9±0. 67g. The Absolved Nitrogen content MIBFP diet, improved significantly (p< 0. 05) by 3. 33±0. 22g than MIBGE diet with 2. 6±0. 02g and control diet with 2. 22±0. 05g. The MIBGE diet improved significantly (p< 0. 05) in Net protein Value (NPV) with 9383. 41±71. 78% than MIBFP diet with 9318. 52±32. 38
%and control diet (8792. 08±60. 95%). The MIBFP diet had the highest Total Digestible Nutrient (TDN) of 48. 26±0. 59% than the control diet (FCW)with 44. 68±0. 35% significantly increase (p< 0. 05) than the MIBGE diet with 39. 17±0. 17%.

Table 4 shows the Initial weight, Final weight and the Weight Gained by the animals used in the trials. Body weight gained values significantly (p< 0. 05) for the formulated diets (MIBFP and MIBGE) from 61. 70g and. 67. 5g and improved to102. 27g and 102. 8g The increase in body weight of the experimental animals (40. 57g and 35. 30g), is an indication of the proper utilization of the protein and micronutrients from the ingredients used in the blending and fortification of the weaning diets. The control diet(FCW) animal groups body weight improved from 59. 83g to 112. 50g and the weight gained for the control animals is 52. 67g. Although the control diet had the highest weight gained of 52. 67g, but compared favourably well with the formulated diets in terms of growth performance index and weight gained by the experimental animals.

Conclusion

Recent advances in research towards formulating and developing weaning food from locally available ingredients have significantly increased the formulation and development of nutritionally and cheap weaning food for newly weaned children. The result of this study as discussed above shows that all the formulated and blended formulas after the processes produced better proximate composition in respect to the necessary nutrients requirements needed by an infant in weaning food and will not be deficient in the required food nutrients for the growth and healthy development of infants and therefore can solve the problem of protein energy malnutrition and other related diseases that affect a child during the weaning stage of life. The formulated diets being comparable with the control diet, can as well replace the commercially market weaning foods which are costly and unaffordable by the economically low income earning nursing mothers. In weaning period the micro and macro-nutrients requirements in relation to the infants weaning foods are key to highest lifespan, healthy living and development. The rapidly growing weaning Infant has no iron stores and has to rely on a rich dietary formula. The presence of protein the diets shows richness of the food.

Consent: It is not applicable

Ethical Approval

The experiments conducted were in accordance with the rulings of the Committee for the purpose of control and supervision of experiments on animals at College of Animals Science Michael Okpara university of Agriculture Umudike, Abia state, Nigeria.

Acknowledgements

The authors are grateful to the postgraduate school, Nnamdi Azikiwe University Awka, Anambra state for their encouragement, National Root Crops Research Institute Umudike Nigeria for providing us with seeds of *Pennisetum glaucum*, leaves of *Telfairia occidentalis* and *Solanum melongena*, Michael Okpara university of Agriculture Umudike for providing us with animal laboratory for the Animal feeding trial.

Competing Interesting

Authors have declared that no competing interests exist.

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