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NUTRIENT COMPOSITION OF SOYA BEAN MEAL AND SOY PROTEIN ISOLATE AND THEIR EFFECTS ON THE GROWTH PERFORMANCE AND HAEMATOLOGICAL PARAMETERS OF ALBINO RATS

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ABSTRACT

Soya bean meal (SBM) and Soya bean protein lsolate(SOPI) were prepared from soya bean seeds. Based on the crude protein content, infant weaner foods was formulated on the substitution of SBM with SOPI and compared with three different commercial infant brand CFF, CFN and CFC, using weight gain,food conversion efficiency , relative organ weight and blood (haematological) constituents as response criteria. The result showed that 100% substitution of SBM with SOPI had the highest crude protein 16.6±0.1g/100g dry matter (DM) ,while among the commercial weaner foods CFC had the highest 16.2±0.1g/100gDM. Infant weaner formulation of SBM or SPOI showed highest growth rate of 3.4±0.2g/rat/day,was in the rats fed diet in which 75%of dietary SBM was replaced with SOPI. The least growth (1.1±0.2g/rat/day) was in the rat fed commercial foods coded CFN or CFF. The relative organ weight (g/kg body weight) of the liver ,kidney, spleen and heart of the rats were within normal ranges irrespective of whether they are fed SBM/SOPI or commercial foods. Haematological assessment showed no significant differences ($p \geq 0.05$) between the rat fed SBM/SPOI based diets and commercial brands with regards to the packed cell volume (PCV),red blood cell (RBC), white blood cell (WBC) and haemoglobin concentration (Hbc). Gross pathological observation of organs using such vital signs as colour, size,edge,and lesions revealed no abnormalities when compared with the controls.

Keywords: Soya bean meal; Soya bean protein lsolate; Performance; Nutrient utilization;haematological constituents.

INTRODUCTION

The role of leguminous seeds in animal and man nutrition in developing countries is well documented (Agbede, 2000). They are rich in nutrients such as digestible protein with good array of amino acid (Agbede, 2000). The percent crude proteins of most legumes vary from 20-50% (Adebowale *et al*., 2003; Aletor *et al*., 2007) and have been judged a good source of minerals (Aletor *et al*., 2007). Leguminous seed have been reported to be excellent sources of energy (Oke *et al*., 1995) in animal and human diets. This explains why considerable research has been directed on harnessing the potential of these seeds in animal and human nutrition.

Soya bean (*Glycine max*) is a leguminous plant which occupies a premier position as a world crop because of its virtually unrivalled protein content and also because it is a rich source of edible vegetable oil (Aletor, 2010; Aletor *et al*., 2007) stated that soya bean has become a primary source of human food and a major anti-dote to the acute protein deficiency in the sub-humid and humid tropics where a large populatin of the world's population live. Among the oil seeds the soya bean assumes a most prominent position, not only in its high protein content but this protein when properly processed, is of good nutritional quality which will stop the problem of malnutrition in Nigeria

While a lot of information on the nutritive potentials of the seed is available (Adebowale *et al*., 2003; Aletor, 2010; Aletor *et al*, 2007) , information on the processing ,formulation and evaluation of the soya bean meal (SBM) and soya bean protein isolate (SOPI) based infant food is scanty.This study is therefore designed primarily to provide analytical data on the SBM and SOPI based infant food and compared with some commercial infants foods with particular refrence to the proximate composition,performance and nutrient utilization ,relative organ weight and gross pathological lesion of organs using rats as animal model.

MATERIALS AND METHODS

Sources of soya bean and commercial infant brand

Some samples of soya bean seeds were purchased from the local market in Akure, Nigeria. The three commercial infant foods coded CFF, CFN and CFC were purchased from a supermarket in Akure They were authenticated in the Department of Crop, Soil and Pest Management of The Federal University of Technology Akure, Nigeria.. The soya bean seeds were cleaned by removing stones and dirts and dried . The dried cleaned seeds were milled and sieved to pass through a 0.5mm mesh. The milled samples were divided into two portions ,one portion was used as soya bean meal (SBM) and the second portion was used to prepare the soya bean protein isolate (SOPI).

Preparation of Protein Isolates

The procedure for isolate preparation was described by Lqari *et al.*, (2001) with some modifications which involved the use of different extractants as mentioned below. The milled samples were sieved to pass a 0.5mm mesh and kept in air-tight plastic container in a refrigerator at 4^{o}C prior to use. The fraction collected (<0.5mm) referred to as flour were defatted by extracting with n-hexane in a soxhlet extractor for 9 hours, followed by air-drying in the fume cupboard for 24 hours.

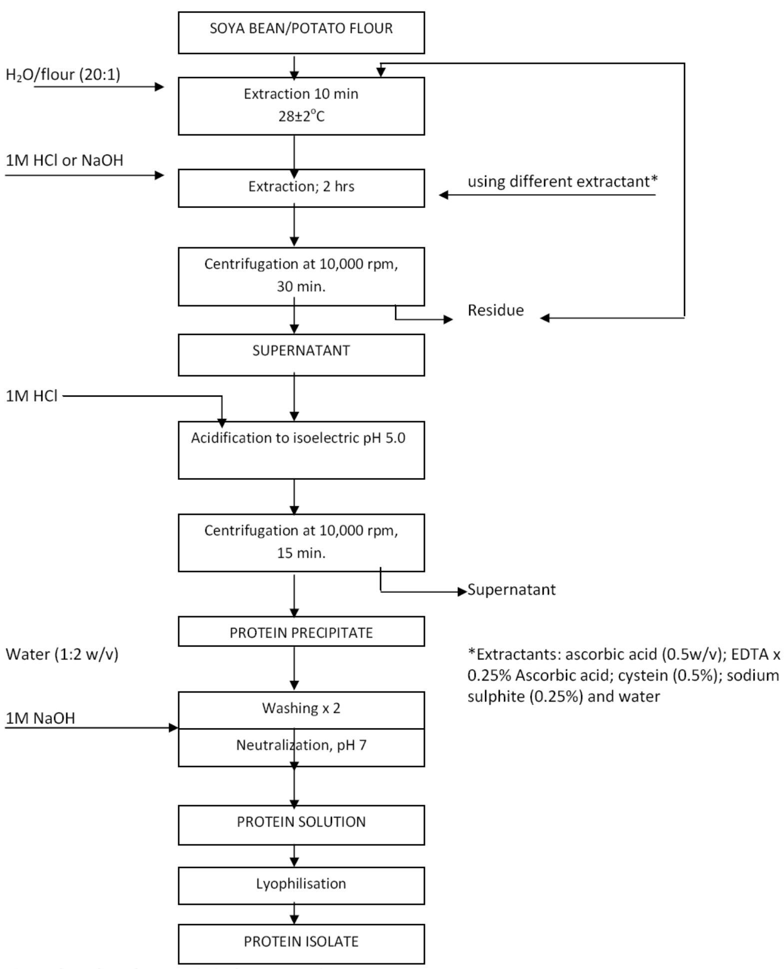

Fig 1: Flow chart for protein isolate extraction

Figure 1: Flow chart for protein isolate extraction

The slurry (1:20, flour to water ratio) at pH 6.37 and 28^{o}C were first extracted for 10 min as indicated in Fig 1. Thereafter, the slurries were stirred for 2 hrs with a Gallen kamp magnetic stirrer and the pH was adjusted to pH 6.5 with 1M NaOH or 1M HCl. Different extractants [ascorbic acid (0.5%) w/v; EDTA + 0.25% ascorbic acid; Cystein (0.5%); Sodium sulphite (0.25%)] and water were added singly. Each extract was centrifuged in a Sorvall RC5C automatic super speed refrigerated centrifuge at 10,000 xg for 30 minutes at 5^{o}C. After centrifugation and recovery of supernatant, three additional extractions were carried out with half of the volume of the initial water. The supernatants were pooled and precipitated at pH 5.0, the isoelectric point (IEP). The precipitates were subsequently recovered by centrifugation at 10,000 xg for 15 minutes at 5^{o}C. The precipitates were washed twice with distilled water adjusted to pH 5.0 with HCl and then freeze-dried. The precipitate was neutralized by the addition of 1M NaOH.

Proximate Constituents

The proximate chemical composition of the soya bean protein isolate based-diets and the commercial infant weaning foods were determined as described by Pearson (1981) and method of AOAC (1995) and the values expressed on dry matter (DM) basis.

Nutritional evaluation of weaning foods

The experimental layout was of completely randomized design. Forty (20 males + 20 females) clinically healthy weanling albino rats of approximately 2 weeks old and weighing between 20.6 and 26.3 g were obtained from the animal house, Department of Veterinary Medicine, University of Ibadan. They were thereafter divided into 8 groups of 5 rats each. The rats were individually housed in separate cubicles in a metabolic cages, with facilities for separate feacal and urinary collection. The rats were offered water and the weanling foods based on the substitution of soya bean protein isolate (SOPI) at the expense of soya bean meal (SBM) to give 16% dietary protein composition of the diets as shown in Tables 1 . Record of the feed consumption was taken daily while the individual weight changes were taken weekly for the 28-days experimental period. Feacal samples were collected daily, bulked for each rat, weighed, dried before storage prior to analysis. Nitrogen contents of the feed and dried feaces were determined by the method of AOAC (1995) and nitrogen retained was calculated as the algebraic difference between feed nitrogen and faecal nitrogen (on dry matter basis) for the period. Apparent nitrogen digestibility was computed by expressing the nitrogen retained as a fraction of the nitrogen intake multiplied by 100. The operative protein efficiency was computed as the ratio of weight gain and total protein consumed for the same period. At the end of the experimental period (28 days), the rats were sacrificed and their blood collected via the jugular vein or the heart into bijour bottles containing a speck of dried ethylenediamine tetracetic acid (EDTA) as an anti-coagulant. Blood collected this way was use for various haematological studies.

Relative Organ Measurement

The following organs: heart, spleen, kidney, lungs and liver were dissected out, weighed and expressed in g/kg body weight.

Haematological Studies

From the blood collected, the PCV (%) was estimated by spinning about 75 μL of each blood sample in heparinized capillary tubes in a haematocrit micro centrifuge for 5 minutes while the total red blood cell (RBC) and white blood cell (WBC) were determined. The haemoglobin concentration(Hbc) was determined using cyano-methaemoglobin method, while the mean corpuscular haemoglobin concentration (MCHC), mean corpsular haemoglobin volume (MCV) were calculated as described by Lamb (1981).

Statistical analysis

All data were means ± SD of duplicate determinations. One way ANOVA (SPSS 11.0 for windows, SPSS Inc. Chicago IL, USA) was used to analyse the mean differences between the dietary treatments. A significant difference was considered at a level of $P \leq 0.05$.

RESULTS

Table 1 shows the compositions of the experimental diets at different percentages (0, 25, 50 and 75%) replacement of soya bean meal (SBM) with soyabean protein isolate. Table 2 shows the proximate composition of the formulated diet. The result showed that all the diet had identical crude protein ranged 15.4± 0.1g/100g in CFN to 16.6 ± 0.1g/100g in diet 5. The formulated diets showed an increase in ethyl extract with highest value 25.7±0.1g/100g in diet 3 and the least 16.2±0.3g/100g in diet 8. Moreover , the formulated diets showed an increase in inorganic matter content as indicated by the higher ash value which was highest in diet 3 (6.4± 0.1g/100g) and least in the commercial diet designated CFC (2.2g/100g).The average weight gain (Table 3) was highest ($p \leq 0.05$) in the formulated diet and ranged from 1.9±0.2g in diet 2 to 3.4±0.2g in diet 4. The rat fed the laboratory formulated SOPI –based foods generally gained more weight than the commercial foods which ranged from 1.1±0.2g/rat/day in CFF to 2.6±0.1g/rat/day in CFC. Food consumption was highest at 100% level of SBM substitution with SOPI (9.7±0.2g/rat/day) in diet 5 and least in diet 2 (6.2±0.1g/rat/day) at 25% soya meal substitution. Food consumption by rats fed laboratory diets were generally significantly ($p \leq 0.05$) higher than those fed commercial diets.The laboratory formulated diets were more efficiently utilized than the commercial brands , except CFC which had similar feed efficiency of 2.9 as against 6.7 and 7.2 for both CFN and CFF respectively .The apparent nitrogen digestibility (%) values were similar ($p \geq 0.05$) in all diets with the highest value shown in CFF (96.7±0.6%) and at 100% substitution level (93.5±3.4%)in diet 5 . Similarly, the operative protein efficiency ratio showed similar values with the lowest value (0.9±0.2) in CFF and highest value of 2.3±0.9 at 50% level of substitution in diet 3.

The effects of the various dietary treatment on the relative organ weights and gross pathology of the rats are shown in Tables 4 and 5. The rats fed SOPI-based diets and those fed commercial foods (Table 4) differed significantly ($p<0.05$) in their relative organ weights . The liver ranged from 37.0±4.5g/kg body weight in rat fed diet 2 to 48.8±1.2g/kg body weight in those fed CFF. The relative weight of the kidney (g/kg body weight) was lowest in diet 2 (6.2±0.5) and the largest weight of 13.6±2.5 was found in those rat fed with CFF . The spleen varied from 3.2±0.4g in rats fed with diet 3 to 7.9±0.1g with rats fed CFN. The weight of the heart was largest (9.7±0.8g) in those with CFN, while the lung had the largest weight of 20.0±0.8g in CFN fed rats.

Table 6 show the haematological indices of rats fed with different SOPI-based infant weaner foods. All the haematological variables of rats fed formulated foods and those fed commercial foods were not significantly different ($p>0.05$) except mean cell volume(MCV), mean corpuscularl haemoglobin(MCH) and Mean corpusular haemoglobin concentrate(MCHC). For example the MCV, MCH and MCHC in SOPI-based diets varied from 50.8±3.3 in CFN to 67.9±13.2μ^3 in CFF, 14.9±0.2 in CFN to 20.9±1pg in diet 1; 32.3±0.8 in diet 5 to 34.8±0.8% in CFF respectively..

DISCUSSION

The result on proximate showed that crude protein was highest at 100% replacement of SBM with SOPI while ether extract and inorganic matter were highest at 50% replacement .It is conceivable that increase replacement of of SBM with SOPI conferred enhanced nutritional value , with regard to SBM gradual substitution with SOPI . This report agrees with that of Aletor (2009) who demostrated that SOPI (with low fibre) may be more useful additive or supplement to enhance the protein or food value of low- nitrogen foods.

With regard to weight gain , feed consumed and feed efficiency in Table 3, this study demonstrates that the rat fed the laboratory SOPI –based weaning foods compared favourably with and in some cases surpasses those fed commercial diets (CFF,CFN and CFC) . The performance of the rats fed diets in which 75% SBM was replaced with SOPI was the best and promoted the best growth.The generally better performance observed for the laboratory formulated diets than the commercial foods, may be ascribed to the better balance of nutrients and proximate constituents as indicated in Table 2. For example, while the CP content were all identical, the crude fat and ash value of the laboratory formulated diets were better. This report corroborates those of Agbede (2003), Fasuyi (2006) and Agbede *et al* (2007) who demonstrated the tremendous potentials of leaf protein concentrates in weaning food. Although the relative organ weights (g/kg body weight) of the rats fed the commercial foods appeared generally higher than those of the laboratory SOPI-based diets, the values were generally within the normal ranges for rats. This was further corroborated by gross pathological observation (Table 5) involving the colour, size, edge or any lesions of the organs. These vital signs were all generally normal for dietary treatments except in some isolated cases in which focal darkened area (FDA) in respect of the spleen (in diet 2) and focal necrosis(FN) in respect of the lungs (in diet 4). This suggest a need to carry out a more detailed histopathological examination of such organs to establish any adverse histopathalogical effects.

To the extent that all the key haematological indices of Packed cell volume(PCV),Red blood cell(RBC) White blood cell(WBC), Haemoglobin concentrate(Hbc) and Erythrocyte sedimentation ratio(ESR) (Table) were identical (and within the norma[physiological ranges) for both the SOPI-based and the commercial weaning foods, implies that the dietary incorporation of these protein had no adverse effects on normal haematopoietic process in the body. The PCV, RBC and Hbc are normally decreased in anaemic condition (Ologhobo *et al*;1986: Aletor and Egberongbe,1992). While WBC may show substantial increase during infection and diseases, the absence of these conditions is an indication of the wholesomeness of the various diets.

Table 1: Composition of experimental diets

	DIETS				
	1	2	3	4	5
	% Soyabean meal replaced with soya protein isolate				
Ingredients	0	25	50	75	100
Maize	60.65	61.70	62.75	63.80	64.85
Soybean meal	12.00	9.00	6.00	3.00	-
SOPI	-	1.95	3.90	5.85	7.80
Milk powder	19.00	19.00	19.00	19.00	19.00
Groundnut cake	5.00	5.00	5.00	5.00	5.00
Vit/mineral premix*	0.25	0.25	0.25	0.25	0.25
Bone meal	2.50	2.50	2.50	2.50	2.50
Oyster shell	0.50	0.50	0.50	0.50	0.50
Salt (NaCl)	0.10	0.10	0.10	0.10	0.10
Total	100.0	100.0	100.0	100.0	100.0
Calculated crude protein	16.61	16.61	16.70	16.79	16.87

*Contained vitamins: A (10,000,000 iµ); D (2,000,000 iµ); E (3500 iµ); K (1900 mg); B_{12} (19 mg); Riboflavin (17,000 mg); Pyridoxine (350 mg); Thiamine (2,200 mg); D Pantenic acid (11,000 mg); Nicotine sacid (45,000 mg); Folic acid (1400 mg); Biotin (113 mg); and Trace elements as Cu (800 mg); Mn (64,000 mg); Zn (40,000 mg); Fe (32,000 mg); Se (160 mg); and other items as Co (400 mg); Choline (475,000 mg); Methionine (50,000 mg); BIIT (5,000 mg) and Spiramycin (5,000 mg) per 2.5 kg.Manufacturer: Embovit NDI by May & Baker Nigeria Plc; SOPI, Soyabean Protein Isolate.

Table 2: Proximate composition (g/100g) of soya bean protein isolate-based diets and commercial infant weaning foods

Diets (foods)	% SBM replaced with SOPI	Dry Matter	Moisture	Crude protein	Ether extract	Crude fibre	Ash	Nitrogen free extract
1	0	96.8 ± 0.1	3.2 ± 0.1	16.4 ± 0.1	17.3 ± 0.1	2.2 ± 0.2	6.2 ± 0.1	54.7 ± 0.1
2	25	96.6 ± 0.1	3.4 ± 0.2	16.1 ± 0.1	25.2 ± 0.1	1.7 ± 0.1	6.0 ± 0.2	47.1 ± 0.0
3	50	96.8 ± 0.2	3.2 ± 0.0	16.3 ± 0.1	25.7 ± 0.1	2.3 ± 0.2	6.4 ± 0.1	46.7 ± 0.1
4	75	97.1 ± 0.1	2.9 ± 0.1	16.4 ± 0.2	23.0 ± 0.2	2.6 ± 0.1	6.3 ± 0.1	47.7 ± 0.1
5	100	96.4 ± 0.1	3.4 ± 0.2	16.6 ± 0.1	23.7 ± 0.2	2.4 ± 0.0	6.3 ± 0.0	49.8 ± 0.2
Commercial diets								
6	CFF	96.6 ± 0.0	3.4 ± 0.2	16.1 ± 0.0	16.3 ± 0.0	2.4 ± 0.1	2.2 ± 0.0	59.6 ± 0.0
7	CFN	94.2 ± 0.1	5.8 ± 0.1	15.4 ± 0.1	18.4 ± 0.0	2.5 ± 0.0	4.0 ± 0.3	53.9 ± 0.3
8	CFC	92.9 ± 0.1	7.1 ± 0.2	16.2 ± 0.1	16.2 ± 0.3	1.1 ± 0.1	3.1 ± 0.2	56.2 ± 0.1

SOPI, Soybean protein isolate; SMB, Soybean meal; CFF, CFN and CFC are coded names for commercial infant foods

Table 3: Performance and nutrient utilisation of rats fed soya bean protein isolate-based and commercial infant weaning foods

Parameters	% SMB replaced with SOPI							
	0	25	50	75	100			
	Laboratory formulated foods (diets 1 – 5)					Commercial foods (diets 6 – 8)		
	1	2	3	4	5	CFF	CFN	CFC
Initial wt. (g)	26.3 ± 10.9	22.7 ± 5.8	21.8 ± 5.8	20.9 ± 5.1	21.9 ± 4.0	20.6 ± 1.9	20.8 ± 1.9	23.2 ± 3.6
Final wt. (g)	98.0 ± 20.7^{b}	81.3 ± 2.8^{ab}	111.7 ± 10.7^{b}	120.0 ± 8.8^{b}	106.4 ± 11.9^{b}	51.6 ± 6.4^{a}	50.0 ± 4.2^{a}	94.1 ± 5.6^{b}
Ave. wt gain (g/rat/day)	2.7 ± 0.4^{c}	1.9 ± 0.2^{b}	3.3 ± 0.2^{cd}	3.4 ± 0.2^{d}	3.3 ± 0.3^{cd}	1.1 ± 0.2^{a}	1.1 ± 0.1^{a}	2.6 ± 0.1^{c}
Ave. feed consumed (g/rat/day)	8.3 ± 1.5^{ab}	6.2 ± 0.14^{a}	8.6 ± 0.6^{b}	8.9 ± 0.3^{b}	9.7 ± 0.2^{c}	7.9 ± 0.5^{abc}	7.4 ± 0.6^{ab}	7.6 ± 0.4^{abc}
Feed efficiency	3.1 ± 0.2^{a}	3.5 ± 0.3^{a}	2.6 ± 1.2^{a}	2.6 ± 0.2^{a}	2.9 ± 0.9^{a}	7.2 ± 0.7^{b}	6.7 ± 0.5^{b}	2.9 ± 0.1^{a}
Nitrogen retention (g/rat/day)	0.2 ± 0.1^{a}	0.9 ± 0.2^{b}	0.9 ± 0.1^{b}	0.9 ± 0.1^{b}	1.0 ± 0.1^{b}	0.2 ± 0.1^{a}	0.2 ± 0.1^{a}	0.2 ± 0.1^{a}
Apparent nitrogendigestibility (%)	88.6 ± 0.8^{abc}	82.6 ± 1.9^{a}	87.1 ± 0.9^{ab}	88.6 ± 2.3^{abc}	93.5 ± 3.4^{cd}	96.7 ± 0.6^{c}	89.3 ± 0.5^{bc}	89.4 ± 2.5^{bc}
Operative protein efficiency ratio	2.1 ± 0.1^{cd}	1.5 ± 0.4^{b}	2.3 ± 0.9^{d}	2.2 ± 0.2^{cd}	2.1 ± 0.2^{cd}	0.9 ± 0.2^{a}	1.9 ± 0.2^{c}	2.1 ± 0.1^{cd}

Means for 5 rats per diet. Means with different superscripts in the same horizontal rows are significantly ($P \leq 0.05$); CFF, CFN and CFC are coded commercial infant weaning foods; SOPI = Soya bean protein isolate; SMB, Soya bean meal

Table 4: Relative organ weights (g/kg body wt) of rats fed soya bean protein isolate-based infant weaner and some commercial infants weaner foods

Diets	% SBM replaced with SOPI	Liver	Kidney	Spleen	Heart	Lungs
1	0	39.5 ± 1.7^{a}	8.4 ± 0.6^{ab}	5.2 ± 2.3^{a}	4.5 ± 0.4^{ab}	8.2 ± 1.2^{a}
2	25	37.0 ± 4.5^{a}	6.2 ± 0.5^{a}	4.0 ± 0.6^{a}	3.2 ± 0.4^{a}	8.6 ± 1.2^{ab}
3	50	40.6 ± 1.5^{ab}	6.9 ± 1.1^{a}	3.2 ± 0.4^{a}	4.6 ± 0.7^{a}	7.0 ± 1.5^{a}
4	75	38.6 ± 2.9^{a}	7.4 ± 0.6^{ab}	4.3 ± 1.7^{a}	4.9 ± 0.8^{b}	7.4 ± 1.0^{ab}
5	100	43.2 ± 0.2^{ab}	8.9 ± 1.9^{ab}	4.0 ± 1.4^{a}	3.6 ± 0.3^{ab}	7.2 ± 1.8^{a}
Commercial weaner foods						
6	CFF	48.8 ± 1.2^{bc}	13.6 ± 2.5^{c}	3.5 ± 1.6^{a}	8.3 ± 0.8^{c}	13.0 ± 2.5^{b}
7	CFN	52.0 ± 4.3^{c}	11.7 ± 0.7^{c}	7.9 ± 0.1^{c}	9.7 ± 0.8^{c}	12.0 ± 0.8^{c}
8	CFC	40.3 ± 0.8^{ab}	7.3 ± 0.8^{ab}	4.6 ± 1.0^{ab}	5.0 ± 0.7^{b}	8.5 ± 0.5^{ab}

Means with different superscripts in the same vertical rows differ significantly ($P \leq 0.05$); SMB, Soybean meal; CFF, CFN and CFC are coded commercial infant weaning foods.

Table 5: Gross pathological lesions of organs of rats fed SOPI-based infant weaning foods and some commercial infant weaning foods

	ORGANS	Foods (Diets) 1	2	3	4	5	6	7	8
Heart	Colour	N	N	N	N	N	F	SC	N
	Size	N	N	N	N	N	N	HP	N
	Edge	N	N	PE	N	N	N	N	N
	Lesion	-	-	-	-	-	-	-	-
Lungs	Colour	N	R	N	N	N	N	N	N
	Size	N	S	N	N	N	N	N	N
	Edge	N	SH	N	N	N	N	N	N
	Lesion	-	SC	-	-	-	-	-	-
Spleen	Colour	N	FDA	N	N	N	N	N	N
	Size	N	N	N	N	N	N	N	N
	Edge	N	N	N	N	FN	N	N	N
	Lesion	-	SC	-	-	-	-	-	-
Kidney	Colour	N	N	N	N	N	N	N	N
	Size	N	N	N	-	N	N	N	N
	Edge	N	N	N	-	N	N	N	N
	Lesion	-	-	-	-	-	-	-	-
Liver	Colour	N	N	SP	N	N	N	N	N
	Size	N	N	N	-	N	N	N	N
	Edge	N	N	N	-	N	N	N	N
	Lesion	-	-	SC	-	-	-	-	-

FD = Fatty degeneration, R = Reddish, C = Congestion, PY = Pale yellow, GS = Glistering surface, FDA = Focal darken area, N = Normal - = Negative, A = Abnormal, SC = Slight congestion, HP = Highly perfuse, SP = Slightly pale, FN = Focal necrosis, F = Friable, S = Small, SH = Sharp, PE = Pointed edge.

Table 6: Haematological variables of rats fed soya bean protein isolate-based diets and commercial infant weaner foods

Diets	% SBM replaced with SOPI	PCV %	RBC x 10^6 mm	WBC X 10^3 mm	Hbc g/100 ml	MCV μ^3m	MCH pg	MCHC (%)	ESR mm/hr
1	0	32.3 ± 2.5	5.4 ± 0.6	6.5 ± 1.3	11.6 ± 0.9	65.2 ± 2.9^{ab}	20.9 ± 1.6^{ab}	33.3 ± 0.4^{ab}	0.6 ± 0.2
2	25	33.3 ± 1.5	5.9 ± 0.4	6.0 ± 0.5	11.2 ± 0.2	55.6 ± 4.3^{a}	18.9 ± 1.4^{ab}	33.9 ± 1.1^{ab}	0.4 ± 0.1
3	50	34.3 ± 3.1	5.0 ± 0.2	5.6 ± 0.7	11.2 ± 0.6	67.0 ± 7.6^{ab}	20.8 ± 1.8^{ab}	32.6 ± 0.6^{ab}	0.8 ± 0.1
4	75	36.6 ± 5.0	4.9 ± 0.1	6.3 ± 1.1	12.4 ± 1.0	74.4 ± 6.7^{c}	25.1 ± 2.2^{ab}	33.8 ± 0.2^{ab}	0.6 ± 0.1
5	100	36.3 ± 5.9	5.9 ± 0.5	5.7 ± 0.4	11.7 ± 0.9	62.2 ± 8.6^{ab}	19.9 ± 3.4^{ab}	32.3 ± 0.8^{a}	0.7 ± 0.2
Commercial weaner foods									
6	CFF	36.3 ± 0.3	4.9 ± 0.6	4.1 ± 0.5	11.2 ± 0.3	67.9 ± 3.1^{ab}	24.4 ± 3.4^{ab}	34.8 ± 0.8^{ab}	0.8 ± 0.1
7	CFN	36.3 ± 0.3	5.3 ± 1.4	5.3 ± 1.6	11.8 ± 0.2	50.8 ± 3.3a	14.9 ± 0.2^{a}	33.2 ± 0.5^{ab}	0.4 ± 0.1
8	CFC	36.7 ± 0.6	6.1 ± 0.4	6.1 ± 1.8	12.3 ± 0.2	60.2 ± 3.6^{ab}	20.2 ± 1.2^{ab}	33.5 ± 0.1^{ab}	0.6 ± 0.1

Means are for 5 rats per diet. Means with different superscripts in the same vertical column differ significantly ($P \leq 0.05$); SOPI, Soyabean isolate; SMB, Soya bean meal; PCV, Packed cell volume; RBC, Red blood cell; WBC, White blood cell; Hbc, Haemoglobin concentrate; MCV, Mean cell volume; MCH, Mean cell haemoglobin; MCHC, Mean cell haemoglobin concentrate; ESR, Erythrocyte sedimentation ratio.

CONCLUSION

It is concluded that when soya bean meal and soy protein isolate are used in complementary fashion, the protein content is largely comparable with those of commercial food brand and they promoted growth in rats more than the commercial infant foods investigated .The relative organs weights and haematological measurements clearly indicated that the soya bean meal /soy protein isolate can safely be used as food components without deleterious effects on the growth of rats.

RECOMMENDATION

Based on the nutritional attributes it is recommended that more research efforts be directed at enhancing soya bean meal /soy protein isolate in infant weaning foods as well as in low-nitrogen foods such as maize gruel (ogi), eko, garri, etc prevalent in the developing countries ,including Nigeria.

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REFERENCES

Agbede, J.O. (2000) Some physicochemical properties of the flour and protein isolates from mucuna bean. A Ph.D. Thesis submitted to the Department of Food Science, The Federal University of Technology,Akure,Nigeria. Pp. 25-27

Agbede, J.O. and Aletor, V.A. (2003) Evaluation of waening foods from glyricidia and leucaena leaf protein concentrates and some commercial brands in Nigeria. Journal of Science in Foods & Agriculture 84, 21-30

Agbede, J.O. and Aletor, V.A. (2004) Chemical characterisation and protein quality evaluation of leaf protein concentrates fom Glyricidia *sepium* and Leucaena *leucocephala*. International Journal Of Science and Technology 39:253-261

Agbede, J. O., Adegbenro, M., Aletor, O. and Mohammed, A. A. (2007). Evaluation of the nutrition value of vernonia amygdialina leaf protein concentrates for infant weaning foods. *Acta Alimentaria*. Vol. 36 (3), pp. 387-393

Adebowale, Y.A., Adeyemi, A. and Oshodi, A.A. (2004). Variability in the physicochemical, nutritional and antinutritional attributes of Six Mucuna species. Journal of Food Chemistry 89 :37-48

Adebowale, Y. A. (2006) Some physicochemical properties of the flour and protein isolates from mucuna bean. A Ph.D. Thesis submitted to the Department of Food Science, The Federal University of Technology, Akure, Nigeria. pp. 25 – 27.

Aletor, V. A. and Egberongbe, O. (1992). Feeding differently processed soya bean. Part 2: An assessment of haematological responses in the chicken. Die Nahrung 36 (4): 364 – 369.

Aletor, O., Agbede, J. O., Adeyeye, S. A. and Aletor, V. A. (2007). Chemical and physico-chemical characterization of the flours and oils from whole and rejected cashew nuts cultivated in Southwest Nigeria. Pakistan Journal of Nutrition 6 (1): 89 – 93.

Aletor. O. (2009). Effect of fermentation on the pyhsico-chemical composition and multi-enzyme *in vitro* protein digestibility of African locust bean and Soya bean. Journal of Chemical Society of Nigeria 34:126-133

Aletor, O. (2010) Nutritive and physico-chemical characteristics of some plants and animal-based protein concentrates. International Journal of Chemical Sciences, Nassarawa, 2 (2): 155-165.

AOAC (1995). Association of Official Analytical Chemists, Official Methods of Analysis (15th edn.), Washington DC: USA

Fasuyi, A. O. (2006). Bio-nutritional evaluations of tropical leaf vegetables (*Telfaria occidentalis, Amaranthus cruentus* and *Talinum triangulae*) as sole source dietary protein sources in rat assay. Journal of Food Chemistry. 103:757-765

Lamb, G.N. (1981).Manual of veterinary Laboratory Technique. CIBA-GEIGY, Kenya, pp 96-97.

Lqari, H., Vioque, J., Pedroche. J., Millan.F. (2001) *Lupinus angustifolious* protein isolates: Chemical composition , functional properties and protein characterization, Journal Food Chemistry 76: 349-356.

Oke, D.B., Tewe,O.O. and Fetuga, B.L. (1995). The nutrient composition of some cowpea varieties. Nigerian Journal of Animal Production 22(1): 32-36.

Ologhobo, A.D., Tewe, O.O. and Adejumo (1986). Proceedings of the 11th Annual Conference of the Nigeria Society for Animal Production, ABU, Zaria Nigeria pp.93-100

Pearson, D. Egan, H. and Sawyer, R. (1981). Pearson's Chemical Analysis of Foods, 8th edition Churchil Livingstone, Edinburgh.