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# Growth and Haematological Response of Broiler Starter Chickens Fed Diets Containing Shea Butter Cake

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## ABSTRACT

This study investigated the proximate, anti-nutritional, amino acid and mineral elements constituent of Shea butter cake (a by-product of shea butter extraction). Proximate analysis of Shea butter cake revealed 92.57% dry matter containing 12.70%crude protein, 5.96%crude fiber, 0.84% oil, 3.77% ash, 76.72%nitrogen free extract -nutrients determined in shea butter cake were phytate(4.60 mg/100g), Hydrogen cyanide(2.90 mg/100g), saponins(1.15 mg/100g) and tannins(0.11mg/100g). Upon establishment of the nutritive values, feeding trial was conducted with two hundred and twenty five 1 day "Ross" broiler chicks, randomly allocated to five treatments in triplicates to investigate the growth performance, haematological characteristics of broiler chicks fed diets containing 0, 10, 20, 30 and 40% shea butter cake meal (SBCM) respectively. Routine vaccination and medication typical of broiler were strictly adhered to. The initial weight, weekly weight, weight gain, feed intake, feed conversion ratio, feed cost/Kg and feed cost/ weight gain were obtained. Result show that birds on control (0%) and 10% SBCM were similar ($p>0.05$) in terms of weight gained 523.33±18.56g and 538.33±6.00grespectively and superior to those of levels 30 and 40% (530.67±4.70 and521.67±5.83). Feed conversion ratio (FCR), cost of feed per Kg, cost of feed per Kg weight gain declined as the level of SBCM increased from 0-40%. FCR for birds on 0 and 10% diets were not significantly different ($p>0.05$). Haematological parameters obtained after the 28-day trial showed that packed cell volume (21.63 -25.53%), haemoglobin (7.21- 8.51g/dl), white blood cell (13.61-14.26x103µl) and mean corpuscular haemoglobin concentration (26.60 – 28.38g/dl) were within acceptable range for avian haematological standards. The health of the birds was not affected by dietary treatments as all indices obtained were within the normal values.
**Keywords:** broiler chicken, growth performance, haematological response, shea butter cake

## I. INTRODUCTION

The West African poultry sector, particularly in Nigeria faces high production costs and technical constraints (Schneilder and Polnick, 2010). Feed accounts for 70 - 80% of the total cost of broiler production in Nigeria (Ademola and Farinu, 2006). The high cost of the conventional poultry feed andrecent advances in modern poultry production have further increased the competition for conventional feedstuffs between livestock industry, agricultural product-dependent industries (confectioneries and distillers) and humans (Bolu and Adakeja, 2008).

In Nigeria, the poultry feed industry is heavily dependent on grains such as maize, millet and sorghum and oilseed resources such as groundnut cake, soybean cake, cotton seed cake and palm kernel meal (RMRDC, 2003). It has therefore become imperative to explore other alternatives for the feed industry in order to reduce the current stress on human food supply situation.

One of the key agro-forestry species in Africa, particularly Nigeria is the shea butter tree, Vitellaria paradoxa syn. Butyrospermum paradoxum (Sapotaceae). The shea tree produces fruits which is cherished and eaten by humans and animals; the nut of this fruit is processed to give shea butter, while the residue or by product is the sheabutter cake (Dei et al., 2008). The shea butter cake is an end product; available in large quantity and generally disposed of via incineration, because it is considered as "useless"; about 500,000MT of this cake are produced annually in the savanna region of West Africa (Okai and Bonsi, 1989). This study was

therefore designed to analyse the shea butter cake and determine its effect on growth and haematological parameters when incorporated in broiler starter diets.

## II. METHODS AND MATERIAL

**Source of Shea butter cake and day old chick**: Dry Vitellaria paradoxa seed cake was collected from a local shea butter processing factory in Zaki-Biam, Ukum Local Government Area, Benue State, Nigeria. The shea butter cake was air dried for 7 days and then pulverized into powder form. Day old Ross chicks were purchased from Zartech farm chicks' depot in Kaduna.

**Proximate Analysis:**

**Determination of Proximate Composition of Shea Butter Cake**

The analyses were carried out in the Biochemical Laboratory of the Department of Animal Science, Ahmadu Bello University(ABU), Zaria according to AOAC (2006) procedures. The metabolisable energy (M.E) was estimated using Pauzenga(1985) formula:

ME = 35 x CP% + 81.8 x EE% + 35.5 x NFE……...……{i}

Where:

ME= Metabolisable Energy, CP= Crude Protein, EE= Ether extract, NFE= Nitrogen Free Extract

Determination of hydrogen cyanide (HCN) (Alkaline titration method)

One gram of dried shea butter cake in duplicate was added to 200ml distilled water for 2hr to collect 150cm3 of distillate. The volume of a 2.5% Volume of 2.5% NaOH was made up to 250cm3 by adding water to the distillate. Part of the distillate sample (100cm3) was added to 8.0cm3 of 6M NH4OH solution and 2.0cm3 of 5% KI, which was then titrated against 0.02M AgNO3 solution using a 10cm3 micro-burette. The end-point was noted as a permanent turbidity against a black background. Titre values were obtained and cyanogenic glycoside contents calculated using the formula:.

Cyanogenic glycoside mg/100g = (TV X 1.08 X EV)/ SM X AL ……{ii}

Where:

TV = Titre value (cm3), EV = Extract volume (cm3), SM = Sample Mass (g)

AL = Aliquot (cm3) used. N/B 1cm3 of 0.02N AgNO3 = 1.08mg HCN.

Determination of phytate

The phytate content of the sample was determined using the method described by Inuwa et al. (2011). Two grammes of each sample were weighed into a 250ml conical flask containing ; 100ml of 2% conc. HCl was used to soak the samples in the conical flask for 3 hours and then filtered through a double layer filter paper. Fifty (50ml) of each of the sample filtrate was placed in a 250ml beaker and 107ml of distilled water added to give/improve proper acidity, 10ml of 0.3% ammonium thiocyanate solution was added to each sample solution as indicator and titrated with standard iron chloride solution which contained 0.00195g iron/ml and the end point was signified by brownish-yellow colouration that persisted for 5min. The percentage phytate was calculated as:

Phytate phosphorus = Iron equivalent x 1.95g of titre……...……{iii}

Phytate = (Phytate phosphorus x 3.65g) x 100……{iv}

Determination of saponins

Saponin extraction was done using acetone and methanol. Crude lipid content of samples was extracted with acetone while methanol was used to extract saponin. Samples (2.0g in duplicate) were folded in a filter paper and put in a thimble and extracted by refluxing in a Soxhlet extractor. Extraction was done with acetone in a 250cm3 capacity round bottomed flask for 3hr after which the apparatus was dismantled and another 150cm3 capacity flask containing 100cm3methanol was fitted to the extractor and extraction sustained for another 3hr. Weight of flask before and after the second extraction was taken to note the change in weight. Methanol was recovered by distillation after the second extraction and the flasks oven-dried, allowed to cool at room temperature and weighed. Saponin content was calculated using the formula:

Saponin (mg/100g) = ((A B)/Sw)/100……..{v}

Where

A = weight of flask and extract, B = weight of empty flask, Sw = sample weight

**Determination of tannins**

One gram of shea butter cake was dissolved in 10ml distilled water and agitated, left to stand for 30 minutes at room temperature. Each sample was centrifuged and the extract recovered, 2.5ml of the supernatant were transferred into 50ml volumetric flask. Similarly, 2.5ml of standard tannic acid solution was transferred into a

separate 50ml flask. A 1.0ml folindennis reagent was measured into each flask followed by 2.5ml of saturated Na2CO3 solution. The mixture was diluted to 50ml in the flask and incubated for 90minutes at room temperature. The absorbance of each sample was measured at 250nm with the reagent blank at zero. The % tannin was calculated using the formular described by Jaffe (2003).

$$T\ (\%) = \frac{(V\text{-}Vo) \times 0.004157 \times 250 \times 100}{W \times 25} \ldots\ldots\ldots\ldots \{vi\}$$

where:
V= Final volume, V0= Initial weight, W= Weight

**Determination of Mineral Contents**

The mineral contents (elements) of V. Paradoxa seed cake: calcium (Ca), magnesium (Mg), potassium (K), sodium (Na), iron (Fe), zinc (Zn), manganese (Mn) and copper (Cu) were determined using the atomic absorption spectrophotometer (AAS-Buck 205), as described by the methods of AOAC (2006). Phosphorus was determined colorimetrically.

**Determination of Vitamin C**

One millilitre of sample was used to make 1-cm pathlength cuvettes. HPLC was performed with an Isco Model 2350 pump (Isco, Lincoln, NE) with a gradient programmer, an UV-VIS detector, and a Hitachi F-1300 fluorescence spectrophotometer (Hitachi, Tokyo, Japan). The column was a 5-.tm (particle size) Sephasil C18 column, 250 X 4.6 mm from Pharmacia LKB, Uppsala, Sweden. Vitamin C as Dehydroascorbic acid was determined by precolumn derivatization of dehydro ascorbic acid with o-phenylenediamine to its quinoxaline derivative. Equal volumes of calibrators and samples were mixed with a 10 mmol/L solution of o-phenylenediamine and incubated at 370C 30 mm in the dark. Of this reaction mixture 200 µl was filtered and injected into the HPLC apparatus. The mobile phase consisted of potassium phosphate buffer (80mmol/L) and 200ml/L methanol adjusted to pH 6 and filtered through a 0.2-µm pore-size filter (Millipore, Bedford, MA). The flow rate was 0.75 ml/min. The fluorescence detector was set to 365 nm excitation and 418 nm emission with 15-nm slit bandpass. Under these conditions the fluorescent derivative was eluted after 7 mm.

Derivatization procedure: Ascorbate oxidase (250 U) was dissolved in 2.5 ml of glycerol plus 2.5 mL of a 100 mmol/L monopotassium phosphate solution adjusted to pH 6; divided into portions; and stored at -80oC. Ascorbic acid calibrators were dissolved in water and used immediately, because ascorbic acid degrades spontaneously in aqueous solutions. To 800 µl of ascorbic acid calibrators or samples we added 20µl of ascorbic acid oxidase solution and let this react for 5 mm at room temperature Vitamin C as ascorbic acid was expressed in percentage.

**Determination of Amino Acids**

Amino acid composition of shea butter cake was measured on hydrolysates using amino acid analyzer (Sykam-S7130) based on high performance liquid chromatography technique. Sample hydrolysates were prepared. Two hundred milligrams of sample were taken in hydrolysis tube. Then 5ml 6N HCl were added to sample into the tube, tightly closed and incubated at 110°C for 24 hours. After the incubation period, the solution was filtered and 200 ml of the filtrate were evaporated to dryness at 140°C for an hour. Each hydrolysate after dryness was diluted with one milliliter of 0.12N, pH 2.2 citrate buffers, the same as the amino acid standards. Aliquot of 150 µL of sample hydrolysate was injected in a cation separation column at 130°C. Ninhydrine solution and an eluent buffer (The buffer system contained solvent A, pH 3.45 and solvent B, pH 10.85) were delivered simultaneously into a high temperature reactor coil (16 m length) at a flow rate of0.7 ml/min. The buffer/ninhydrine mixture was heated in the reactor at 130°C for 2 minutes to accelerate chemical reaction of amino acids with ninhydrine. The products of the reaction mixture were detected at wavelengths of 570 nm and 440 nm on a dual channel photometer. The amino acid composition was calculated from the areas of standards obtained from the integrator and expressed as percentages of the total protein.

**Chemical Assay:** The proximate components (crude protein, ether extract, crude fibre, ash and moisture) and mineral fractions of Shea butter cake were analyzed using AOAC (2006) procedures.

**Experimental Design:** Two hundred and twenty five 1 day-old 'Ross' broiler chicks were randomly divided into five treatments of 15 birds each, replicated three times in a complete randomized design (CRD).

**Experimental Diets Formulation:** Five (5) diets were formulated with different inclusion levels of 0(diet 1),

10(diet 2), 20(diet 3), 30(diet 4) and 40%(diet 5) Shea Butter Cake (SBC) respectively (Table i).

**Management of Experimental Birds:** Birds were raised under battery caging system of management using 1.05×1.30m pen sizes. Feed and water were supplied ad-libitum while vaccination and medications were administered as recommended for the study area.

**Data collection**

Data were collected on the growth performance and blood parameters. A weighed quantity of feed was fed daily and feed intake calculated as the difference between the left over and the quantity fed the previous day. The birds were weighed at the beginning of the experiment and weekly thereafter and daily gain calculated by dividing the weight difference between 2 consecutive weightings by 7 (number of days in the week). Feed conversion ratio was derived as feed consumed: Weight gained. At the end of the 4 weeks of the experiment, 6 birds were randomly selected per treatment (i.e. 2 birds per replicate), fasted overnight and used for haematological studies. Haematological samples were collected into sample tubes containing ethylene diamine tetra acetic.

**Statistical Analysis:** Data obtained were subjected to analysis of variance (ANOVA) using SAS version 15.0 for windows. Means were separated using Duncan Multiple Range Test.

## III. RESULTS AND DISCUSSION

**Proximate composition:** Shea butter cake contained 12.70% crude protein, 5.96% crude fibre, 0.84% lipid, 3.77% ash, 76.72% nitrogen free extract (Table i). Elemental composition of the cake were Ca (1.85mg/100g), K (0.99mg/100g), Mg (0.38mg/100g), Na (1.05mg/100g), Fe (1.06mg/100g), P (0.40mg/100g), Zn (5.676mg/100g), and Cu (0.55 mg/100g). The essential amino acids composition was Arginine (1.89g/Kg), Histidine (0.50g/Kg),Isoleucine (1.01g/Kg), Leucine (1.34g/Kg), Lysine (1.28g/Kg), Methionine (0.38g/Kg), phenylalanine (1.75g/Kg), Valine (1.25g/Kg) and Threonine (0.95g/Kg); while the non-essential amino acids were glutamic acid (3.56g/Kg), aspartic acid (1.96g/Kg) Cystine (0.35g/Kg), proline (1.30 g/Kg), tyrosine (1.10g/Kg), serine (1.25g/Kg), alanine (0.75g/Kg) and glycine (1.25 g/Kg). Vitellaria paradoxa seed cake contained phytate (4.60 mg/100g), Hydrogen cyanide (2.90 mg/100g), saponins (1.15 mg/100g) and tannins (0.11mg/100g) (Table ii).

**Performance of Experimental Birds:** The body weight gain (BWG) and daily weight gain (DWG) of birds fed diets 1 and 2 were statistically similar ($P > 0.05$) (Table 3). The values of BWG of treatments 1, 2, 3, 4 and 5 were 523.33, 538.33, 532.33, 530.67 and 521.67g, respectively. However, treatments 1 and 2 had the highest BWG values of 538.33 and 532.33g. The 4th week feed intake (FI) of the birds fed diets 1 (411.08g) and 2 (413.67g) were similar ($P > 0.05$) but significantly ($P<0.05$) higher than those fed diets 3 (406.75g), 4 (404.44g) and 5 (402.85g) (Table iii). The FCR of the birds were similar ($P>0.05$) among the diets 4 and 5 but those on diets 1, 2 and 3 had the best FCR.

**Blood haematological characteristics:** Packed cell volume (PCV), Haemoglobin, White blood cell count and mean corpuscular haemoglobin count values for broilers on diet 2 was similar for broilers on diet 1(control diet), while haematological values of birds on diets 3 and 4 were also similar but they differ significantly ($p<0.05$) to those of the control diet. Broilers on diet 5 also had values which was significantly different ($p<0.05$) from those on the control diet.

**Cost Benefit of Finisher Broiler Production:** The economic performance showed that the cost per kg of the feed reduced steadily as the level of SBCM increased in the diets from ₦94.00 in diet 1 to ₦84.000 in diet 5; while cost of feed intake reduced from ₦91.13 (diet 1) to ₦77.73. Similarly, feed cost/kg weight gain followed the same trend.

**Discussion:** The dry matter content the shea butter cake observed in this study was within the range reported by NRC (1994); Donlaporn and Worapot (2011). Variation in the nutrient composition of Shea butter cake extract given by earlier workers (Atuahene et al., 1998; Zanu et al., 2012) maybe due to the traditional method used in the processing of the shea butter cake which involves higher heat treatment than other known methods, and high processing temperatures of oilseeds has deleterious effects on proteins, minerals and amino acids (Hurell, 1990). The higher residual fat in SBC reported in this study was expected since the traditional method of fat extraction is known to be inefficient, and as such higher

fat residue is anticipated in the by-product. Variation in fat content of shea butter cake may also be due to geographical location of the shea butter tree which is supported by Maranz and Wiesman (2004) who reported variation in lipid content across four climatic zones of several African countries. The 3.77% ash content for Shea butter cake obtained in this study is an indication of its low level of mineral elements. Higher ash content has been reported in several raw materials used for poultry and other livestock (An ash value of 5.5% for shea butter kernel reported by Ugese et al. (2010), while Rami-Reddy et al. (2008) reported 10.25% for shea butter extract, Atuahene et al. (1998) reported 4.2% and Dei et al. (2008) 5.23% ash for unfermented shea nut meal.

This low level of tannin, Phytate concentration, Saponin in this study is within the tolerance level for poultry birds (Inuwa et al., 2011). The tannin concentration is also low compared to the report of Dei et al. (2008) for fermented shea butter nut and unfermented shea butter cake respectively. Phytates in foods are known to bind with essential minerals (such as calcium, iron, magnesium and zinc) in the digestive tract, resulting in mineral deficiencies (Bello et al., 2008). The low concentration of antinutrients can be attributed to the long heat processing of the SBC during production; USAID (2007) reported that SBC passed through boiling at a temperature of 120oC which invariable reduced the level of tannin in the SBC.

Some amino acid concentration, such as methionine, leucine, histidine in this study were lower than those reported by Dei et al. (2008) for unfermented shea butter cake. Heating which is known to denature protein and amino acids may be responsible for the low concentration of the amino acid. On the contrary Cystine, threonine, arginine, isoleucine, valine and phenylalanine were on the high side but Lysine content in this study concurred with the report of Dei et al .(2008). The level of essential and non-essential amino acid in SBC in this study is a pointer to its potential as a substitute to protein source in poultry feed ingredients.

The improvement in the performance of broiler fed the control diet (0%) and 10% inclusion level of SBC compared with other dietary treatment may be due to low crude fibre and antinutritional factors and palatability of the diets which enhance consumption and hence increase in weight of the broilers. The declining trend in growth observed in weekly live body weight as the inclusion of shea butter cake increased is similar to the findings of Annongu et al. (2006) and Olorede and Longe (1999).

Feed intake was inversely related to the increasing levels of shea butter cake in the diets, and higher inclusion of SBC did not favour the feed intake of the birds, The decline in feed consumption with increasing levels of shea butter cake meal in this study is similar to the result of Atuahene (1998) and Olorede and Longe (1999) during which pullets feed consumption reduced as the inclusion level exceeded 10% shea nut cake in the diet.

Body weight gain had a similar trend to feed intake. The decreased weight gain at higher SBC inclusion level was partly due to low feed intake, which is related to the poor digestibility and absorption of nutrients in shea butter cake diets. The poorer growth rate of broiler chicks fed 40% inclusion level of SBC based diet may be attributed to the lower feed intake and poor palatability of the ingredient. Olorede and Longe (1999) and Dei et al. (2008) had earlier observed growth depression when SBC was included at higher percent (>10%) in pullet chicks' diet also. The decreasing weight has been related to the fact that weight gain in broiler is directly related to feed intake, the quality of the feed as well as how efficiently the birds utilize the feed (Egbunike et al., 2009).

The superior FCR of birds on 0 and 10% SBC inclusion diets to other inclusion level (20%, 30% and 40%) suggests that there was enhanced availability, digestion, absorption and utilization of the nutrients in the cake by broilers. level. Similar observations have been reported by Dei et al. (2008) while feeding broilers with shea butter meal. The haematological parameters data (PCV, Hb, WBC and MCHC) obtained in this study though differed significantly among the group but was within normal range for packed cell volume (21-35%), haemoglobin and MCHC in broilers (Fasuyi and Nonyerem, 2007). This observation suggests that the health of the birds were not compromised throughout the study period. The values obtained for all the treatment groups indicate nutritional adequacy of all diets, since values did not indicate mal-or under nutrition.

The lower haematological data obtained in birds fed 20%, 30% and 40% inclusion diet may be ascribed to the higher concentration of tannin in SBC diet.

**Table i: Proximate and Elemental Composition of Shea Butter Cake**

| Nutrient | (% of Dry Matter) |
|---|---|
| Dry matter | 92.57 |
| Crude protein | 12.70 |
| Oil | 5.96 |
| Nitrogen Free Extract | 0.84 |
| Calcium | 3.77 |
| Potassium | 76.72 |
| Magnesium | 0.38 |
| Phosphorus | 0.40 |
| Sodium | 1.05 |
| Iron | 1.06 |
| Zinc | 0.57 |
| Copper | 0.55 |
| Vitamin C (%) | 0.09 |

**Table ii: Anti-nutrient Composition of Formulated Starter Broiler Diet (23%) CP**

| Anti-nutrient | (% of Dry Matter) |
|---|---|
| Phytates | 4.60 |
| Saponin | 1.15 |
| Tannin | 0.11 |
| Hydrogen cyanide | 2.90 |

**Table iii: Amino Acid Composition of Shea Butter Cake**

| Nutrients | (g/Kg) |
|---|---|
| Methionine | 3.8 |
| Cystine | 3.5 |
| Lysine | 12.8 |
| Threonine | 9.5 |
| Arginine | 18.9 |
| Isoleucine | 10.1 |
| Leucine | 13.4 |
| Valine | 12.5 |
| Histidine | 5.00 |
| Phenylalanine | 17.5 |
| Glycine | 12.5 |
| Aspartic acid | 19.6 |
| Serine | 12.5 |
| Glutamic acid | 35.6 |
| Alanine | 7.5 |
| Tyrosine | 11.0 |
| Proline | 13.0 |

**Table iv: Composition of Formulated Starter Broiler Diet (23%) CP**

| | Diets (% Inclusion Levels) | | | | |
|---|---|---|---|---|---|
| **Ingredients** | **1 (0%)** | **2 (10%** | **3 (20%)** | **4 (30%)** | **5 (40%)** |
| Maize | 57.99 | 44.62 | 35.53 | 27.07 | 17.55 |
| Groundnut | 35.26 | 36.33 | 34.72 | 36.18 | 35.69 |
| Shea Butter cake | - | 10.00 | 20.00 | 30.00 | 40.00 |
| Bone Meal | 2.75 | 2.75 | 2.75 | 2.75 | 2.75 |
| Salt | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| Vit. Min Premix | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| Lysine | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| DL. Methionine | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 |
| Limestone | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 |
| **Calculated analysis** | | | | | |
| Crude protein (%) | 22.99 | 22.99 | 22.99 | 22.99 | 22.99 |
| Methionie (%) | 0.50 | 0.48 | 0.48 | 0.45 | 0.45 |
| Calcium (%) | 1.22 | 1.23 | 1.22 | 1.24 | 1.23 |
| Phosphorus (%) | 0.74 | 0.79 | 0.77 | 0.83 | 0.81 |
| Lysine (%) | 1.25 | 1.23 | 1.21 | 1.23 | 1.21 |
| ME Kcal/Kg | 2798 | 2798 | 2798 | 2798 | 2798 |
| Cost per Kg (₦) | 94.00 | 90.00 | 88.50 | 85.25 | 84.00 |

**Table v: Effect of Shea Butter Cake Diets on Performance of Birds**

| | Diets (% Inclusion Level) | | | | |
|---|---|---|---|---|---|
| **Parameters** | **1 (0%)** | **2 (10%)** | **3 (20%)** | **4 (30%)** | **5 (40%)** |
| Live Body weight | 968.33±15.89$^{a}$ | 968.33±4.41$^{b}$ | 930.00±2.89$^{b}$ | 915.00±7.64$^{b}$ | 900.00±2.89$^{b}$ |
| Feed intake | 411.08±0.85$^{a}$ | 413.67±0.79$^{a}$ | 406.75±0.29$^{bc}$ | 404.44±0.56$^{c}$ | 402.85±1.02$^{c}$ |
| Body weight Gain | 523.33±18.56$^{a}$ | 538.33±6.00$^{a}$ | 532.33±7.88$^{b}$ | 530.67±4.70$^{b}$ | 521.67±5.83$^{c}$ |
| Feed Conversion Ratio | 0.79±0.026$^{b}$ | 0.77±0.009$^{b}$ | 0.77±0.007$^{a}$ | 0.76±0.011$^{a}$ | 0.77±0.011$^{a}$ |

Means with the same superscript in each row are not significantly different (P>0.05)

**Table vi: Effect of Shea Butter Cake Diets on Some Blood Variables**

| | Diets (%inclusion level) | | | | | |
|---|---|---|---|---|---|---|
| **Parameters** | **1 (0%)** | **2 (10%)** | **3 (20%)** | **4 (30%)** | **5 (40%)** | **Normal Values** |
| PCV (%) | 25.53±0.06$^{a}$ | 25.17±0.06$^{a}$ | 23.33±0.16$^{b}$ | 23.13±0.18$^{b}$ | 21.63±0.03$^{c}$ | 22-35 |
| Hb (g/dl) | 8.51±0.02$^{a}$ | 8.39±0.02$^{a}$ | 7.78±0.05$^{b}$ | 7.71±0.06$^{b}$ | 7.21±0.01$^{c}$ | 7-13 |
| WBC (x10$^{3}$µl) | 14.26±.011$^{a}$ | 14.19±.011$^{a}$ | 13.89±.028$^{b}$ | 13.86±.030$^{b}$ | 13.61±.006$^{c}$ | |
| MCHC (%) | 27.53$^{a}$ | 28.38$^{ab}$ | 27.16$^{b}$ | 27.93$^{b}$ | 26.60$^{c}$ | 26-35 |

Means with the same superscript in each row are not significantly different (P>0.05)

**Table vii: Cost of Feeding With Different Dietary Treatments**

| | Diets (%inclusion level) | | | | |
|---|---|---|---|---|---|
| | **1 (0%)** | **2 (10%)** | **3 (20%)** | **4 (30%)** | **5 (40%)** |
| Feed cost/100Kg (₦) | 9400.00 | 9000.00 | 8800.50 | 8525.00 | 8400.00 |
| Feed cost/Kg (₦) | 94.00 | 90.00 | 88.00 | 85.25 | 84.00 |
| Total Feed intake (g/bird) | 969.2 | 969.48 | 950.08 | 937.22 | 919.46 |
| No. of days on feed | 28 | 28 | 28 | 28 | 28 |
| Total cost of feed (₦) | 91.13 | 87.25 | 84.08 | 79.89 | 77.73 |
| Feed cost/Kg weight gain | 98.70 | 94.77 | 94.96 | 91.81 | 90.72 |

## IV. CONCLUSION

Considering that weight gain and FCR were negatively influenced as dietary SBCM level increased beyond 10%, it is recommended that SBCM should not be used in broiler starter diets at levels exceeding 10%.

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