

GROWTH PERFORMANCE, HAEMATOLOGY AND SERUM BIOCHEMICAL INDICES OF STARTER BROILER CHICKS FED DIETS CONTAINING PROCESSED FULL FAT SOYBEAN AND GROUNDNUT CAKE

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ABSTRACT

A 28 d study was conducted using two hundred (200) day old broiler chicks (Arbor Acres) to investigate the effect of processed soybean meal and groundnut cake on growth performance, haematology and serum biochemistry of starter broiler chickens. Birds were allotted to dietary treatments in completely randomized design. Each treatment was replicated 4 times containing 10 chicks per replicate. The birds were fed five diets which consist of sun dried soybean meal (SDSBM) as T1, steamed soybean meal (SSBM) as T2, toasted soybean meal (TSBM) T3, industrial groundnut cake (IGNC) T4 and local groundnut cake (LGNC) T5. Diets containing groundnut cake and full fat soya bean meal subjected to different processing methods showed significant ($P < 0.05$) influence on final weight, total weight gain, daily weight gain feed intake and feed conversion ratio of starter broiler chickens. Birds fed diet containing Steamed Soybean meal (SSBM) showed higher ($P < 0.05$) value of 942.50g for final weight. Least significant ($P < 0.05$) value of 681.25g was recorded for final weight in the birds fed LGNC diet. Birds fed diet containing SSBM (T2) showed least ($P < 0.05$) values 1.33 for feed conversion ratio (FCR). Results on haematological parameters revealed significant ($P < 0.05$) influence on mean corpuscular haemoglobin concentration (MCHC), mean cell haemoglobin (MCH) and mean cell volume (MCV) with birds fed IGNC showed least values (48.87g/dl and 40.00fl) for MCHC and MCV. Dietary treatments had no significant ($P > 0.05$) effect on parameters determined for serum biochemical indices. Based on the findings of this study, inclusion of steamed soybean meal (SSBM) in the diets starter broiler chickens improved growth performance and feed efficiency without hazardous effect on starter broiler chicks.

Key words: Broiler chicks, Full fat soybean, Groundnut cake, Growth performance, Haematology, Serum.

INTRODUCTION

The poultry industry worldwide represents an increasingly intensive operation supplying high quality protein in the form of both meat and eggs to major sectors of the human population. Intensively reared poultry are invariably fed on diets of high nutrient concentration where nutrient requirements are met with the use of high quality raw materials. One of the major developments in compound feed formulation is the considerably more detailed information relating to the nutritive value of the raw materials available for incorporation into diets, the possible variation between sources of the feed materials and the influence of processing. A major constraint in the development of poultry industry in most tropical countries is the scarcity of animal protein sources being incooperated along with plant protein sources to make up the needed

amino acid profile (Dafwang *et al.*, 1999). However, the use of fishmeal, meat meal, blood meal is restricted due to problems like development of off-flavor incidence and intestinal disorder, which make it somewhat unpalatable, (Olomu, 2013).

A major problem facing poultry production in Nigeria is high cost of feeds which necessitated the feed manufacturers to frequently vary their formula and the ingredient being used. Mustafa *et al.* (2012) observed that livestock production performance in Nigeria is far below the actual potential vis-a-vis the output from the resource available. Soybean meal and groundnut cake are the major oil seed in the world that provide approximately 60% of vegetable protein and 30% oil (Oluyemi and Robberts, 1988).

According to (Ojewola *et al.*, 2012), the requirement of feed for growing poultry industry in Nigeria is about 6.5 million tons per annum

where vegetable protein source constitutes around 30% of the total compounded poultry diet. Other commonly used plant protein sources includes seed meals of sesame, sunflower, mustard (Patneck and Schaible, 1980). The amino-acid composition of majority of the oil seed meals is deficient in one or more critical amino acids like methionine and lysine (Steenfeld *et al.*, 2012). Another limiting factor to the free use of oil seed meals is the presence of anti-nutritional factors such as ptyalin in soybean, aflatoxin in groundnut cake and gossypol in cotton seed cake. Nevertheless, several attempts have been made to detoxify the oil seed meals for effective usage in practical ration, (Shaib *et al.*, 1997). Groundnut (*Arachis hypogea*) meal has been a major source of vegetable protein in poultry diet in Nigeria. However it contains trypsin inhibitor that limit the use of raw groundnut meal. This trypsin inhibitor can be destroyed by mild heating. So, solvent extracted groundnut meal is mostly used and it contains 43 to 48% crude protein. It is an excellent source of arginine but deficient in lysine, cystine, and methionine supplementation of synthetic lysine to groundnut meal can make it ideal protein source in poultry feeds.

Groundnut seed coat contains tannins, apolyphenolic substance that lowers the quality of protein content of groundnut. Soya bean (*Glycin max*) meal is a good source of protein for poultry; it contains 45-52% crude protein (Ojewola *et al.*, 2012). The amino acid profile of soya beans meal is well balanced and is an excellent source of lysine to the poultry. Soybean contain trypsin inhibitors which cause enlargement of pancreas in chicks as observed by (Ojewola *et al.*, 2012), therefore it is usually subjected to heat treatment prior to use as animal feed in order to destroy the anti-nutritional factors. Anti-nutritional factors in soy bean are thermo-labile and can be destroyed by roasting, heating, or autoclaving. Therefore, the efficacy of differently processed soybean and groundnut cake in nutrient bioavailability was evaluated on growth performance, haematology and serum biochemical indices of starter broiler chicks.

MATERIALS AND METHODS

Experimental site

The experiment was conducted at the Poultry unit of the Teaching and Research Farm of the Taraba State University Jalingo located between latitude 6° 30' and 9° 30' N and longitude 9°00' and 12°00' E in Guinea Savannah Zone of Northern Nigeria (Kefas *et al.*, 2020). It has an annual rainfall range of 1000mm – 1500mm, the ambient temperature of the area range between 30 – 38°C with an average of 29°C.

Test Ingredient and Preparation

Two protein sources namely groundnut cake and full fat soybean were purchased at Jalingo central market. Local groundnut cake (LGNC) and industrial groundnut cake (IGNC) were milled before incorporation into diet. Full fat soybean meal was subjected to three differently processing method, sun dried, steamed and toasted before being used for compounding diet.

Sundried Soybean Processing.

Soybean seeds were milled to a 2mm size and spread on a clean concrete cement floor for three days. The beans were dried under intense sunlight during the period to ensure proper low moisture content and reduce anti-nutritional factors which are heat labile. The dried soybean meals were then bagged for compounding.

Steamed Soybean Processing

Raw dried soybeans were milled into small particle size of 2mm. A drum was placed on a tripod stand. 20 liters of water was poured into the drum and a net with metal stand was placed at the bottom of the drum before pouring soybean meal to prevent coming in contact with the water in the drum. Heat was applied through fire wood and the drum was covered to avoid water vapour from escaping to direct atmosphere. Intense heat was applied for one hour after which the soybean meal produced a sweet scent and the colour changed from golden color to brown. The soybean meal was allowed to cool before it was bagged for compounding.

Toasted Soybean Processing

Soybean seeds were milled to a 2mm size and were toasted in a metal pot with fire wood as heat source, the soybean meals were stirred consistently with a stir rod to have a uniform toast and prevented burning. The toasting was carried out until the colour changed to golden brown. The beans were spread out on a concrete floor before being bagged.

Experimental diets

A total of five isonitrogenous diets were formulated for starter chicks to meet NRC (1994) minimum nutrient requirement. Five dietary treatments were formulated to consist: Sun dried soybean meal (SDSBM) as T1, Steamed soya bean meal (SSBM) T2, Toasted soya bean meal (TSBM) T3, Industrial groundnut cake (IGNC) T4, and Local groundnut cake (LGNC) T5 respectively as presented in Table1.

Table 1: Percentage Composition of Broiler Starter Diets (0-4 Weeks)

Protein Sources Ingredients	T1 SDSBM	T2 SSBM	T3 TSBM	T4 IGNC	T5 LGNC
Maize (%)	48.00	48.00	48.00	55.20	55.20
SBM (FFS) (%)	39.10	39.10	39.10	0.00	0.00
GNC (%)	0.00	0.00	0.00	33.40	33.40
Fish meal (%)	3.50	3.50	3.50	2.00	2.00
Rice offal (%)	5.00	5.00	5.00	5.00	5.00
Bone meal (%)	3.50	3.50	3.50	3.50	3.50
Lysine (%)	0.10	0.10	0.10	0.10	0.10
Methionine (%)	0.30	0.30	0.30	0.30	0.30
Salt (%)	0.25	0.25	0.25	0.25	0.25
Premix (%)	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100
Calculated Analysis					
ME (kcal/kg)	2,972.35	2,972.35	2,972.35	2,891.37	2,891.37
Crud protein (%)	22.20	22.20	22.20	22.29	22.29
Fibre (%)	3.77	3.77	3.77	3.41	3.41
Fat (%)	9.52	9.52	9.52	4.69	4.69
Calcium (%)	1.14	1.14	1.14	1.03	1.03
Phosphorus (%)	0.67	0.67	0.67	0.63	0.63
Lysine (%)	1.42	1.42	1.42	0.91	0.91
Methionine (%)	0.65	0.65	0.65	0.55	0.55

*Biomix chick premix provided per kg of diet: Vit A, 10,000 IU; Vit D3 32,000 IU; Vit E 23,000 mg; Vit K 2,000mg; Vit. B1 1,800 mg; Vit. B2 5,000mg; Pantothenic acid 7,500mg; Vit.B12 150mg; Folic acid 750mg; Biotin 100mg; Choline chloride; 300,000mg; Cobalt 3,000mg; Iodine 1,000mg; Iron 20,000mg; Manganese 40,000mg; Selenium 200mg; Zinc 30,000mg; Antioxidant 1250mg.

SDSBM = Sun Dried Soya Bean Meal, **SSBM**= Steamed Soya Bean Meal, **TSBM** = Toasted Soya Bean Meal, **IGNC** =Industrial Groundnut Cake, **LGNC** = Local Groundnut Cake

Design and Management of Experimental Birds

A total number of 200 day-old unsexed broiler chicks of commercial strain (arbor acre) were purchased from Zartech Hatchery Farm in Ibadan Oyo State Nigeria. The chicks were weighed and allotted to five dietary treatment groups of four replicates each in a Completely Randomized Design. Each replicate consist of 10 chicks, to have a total of 40 birds per treatment group. The birds were brooded for two weeks. Birds were reared on deep litter housing

system for four weeks (0-4 weeks). Routine vaccinations and medications were strictly followed and feed and water given *ad libitum*.

Data Collection

Growth Performance characteristics

The initial weights of the birds were taken on arrival. The live weights of the birds as well as the feed consumption of each replicate were measured weekly. Feed conversion ratio for each replicate were determined by dividing the feed intake by the weight gain.

$$\text{Feed intake/bird (g)} = \frac{\text{Quantity of feed fed} - \text{Quantity of feed left over}}{\text{Number of birds} \times 28 \text{ days}}$$

$$\text{Daily weight gain (g)} = \frac{\text{Final live weight} - \text{Initial weight}}{\text{Number of birds} \times 28}$$

$$\text{Feed conversion ratio} = \frac{\text{Quantity of feed consumed}}{\text{Weight gain}}$$

Blood Analysis

At the end of 28th day, blood samples were drawn from the wing vein of 4 birds per treatments that is one from each replicates. 2ml of blood sample was transferred into a bottle containing Ethylene Diamine Tetra Acetic Acid (EDTA) for haematological analyses. The parameters determined include Packed Cell Volume (PCV), White Blood Cell (WBC), Haemoglobin (Hb), Red Blood Cell (RBC), Mean Cell Haemoglobin Concentration (MCHC), Mean Cell Haemoglobin (MCH) and Mean Cell Volume (MCV). 2ml of blood was collected into a clean syringe and put in plane bottle for serum biochemical analyses. The blood samples were allowed to clot, they were refrigerated for 6 hours and then spun in a centrifuge at 900 rpm for 20 minutes. The separated serum were stored in the freezer at -2°C prior to analysis for serum metabolites such as serum total protein, albumin, globulin, creatinine, uric acid and cholesterol.

Statistical Analysis

Data collected were subjected to One-way Analysis of Variance (ANOVA) in a Completely Randomized Design using SAS (2000) while significant means was separated using Duncan's Multiple Range Test at 5% level of significance.

RESULTS AND DISCUSSION

The result of growth performance of starter broiler chickens fed diet containing differently processed soya bean and groundnut cake is presented in Table 2. Differently processed soya bean and groundnut cake showed significant ($P < 0.05$) effect on all parameters measured. Birds fed diet with SSBM inclusion T2 showed higher ($P < 0.05$) value of 942.50g for final weight compared to those on other diets treatments. Similar values ($P > 0.05$) of 744.25g, 745.00g and 681.25g were recorded for final weight in the birds fed diets containing SDSBM,

IGNC and LGNC respectively. Least significant ($P < 0.05$) value of 681.25g was recorded for final weight in the birds fed LGNC diet. The observation in this study is in agreement with the findings of Aguiue *et al.* (2013) who reported that higher inclusion level of LGNC retarded growth performance and less nutrient digestibility. Bioavailability of protein is of great importance. Protein is of paramount importance for the synthesis of body tissues, muscles build up and consequently for growth. Retardation in growth and poor feathering in poultry can be associated to protein deficiency and amino acids are of greatest nutritional importance (Oluyemi and Roberts, 1988). Improved growth performance observed with birds fed SSBM and TSBM could be attributed to good amino acid profile coupled with bioavailability of the nutrient due to efficient heat penetration during steaming process. Anti-nutritional factors are heat labile and adequate heat penetration reduces the level of anti-nutritional factor.

Total weight gains and daily weight gain followed similar trend with final weight. Birds fed diet with SSBM recorded higher ($P < 0.05$) value of 902.43g for total weight gain. Similar values 704.13g, 704.93g and 641.18g were recorded for total weight gain in the birds fed SDSBM, IGNC and LGNC respectively. Birds fed diet with LGNC (T5) recorded the least ($P < 0.05$) value of 641.18g for total weight gain. This observation could be attributed to inefficient processing and in turn presence of aflatoxin as anti-nutritional factor which affected nutrient bioavailability and in consequence inefficient nutrient utilization by the birds. The result of this study corroborated the findings of Lakurbe *et al.* (2018) who reported highest weight gain in broiler chickens fed maize based diet with boiled soya bean compared to bird fed maize based diet with IGNC and LGNC. Observation in this study was in contrast to findings of Lalshaw and Clayton (2015) who reported lower weight gain in broiler chicken fed roasted soya bean compared to GNC. Birds fed diet containing SSBM revealed higher ($P < 0.05$) value 1202.13g for total feed intake. Similar ($P > 0.05$) values of 1104.20g and 1019.62g were recorded for feed intake in the birds fed TSBM and IGNC respectively. Birds fed diet containing SSBM (T2) and TSBM (T3) showed

least ($P < 0.05$) values of 1.33 and 1.38 or feed conversion ratio (FCR) at comparative level across dietary treatments. Higher significant ($P < 0.05$) value of 1.52 was obtained for FCR in the birds fed LGNC. The observation in this study corroborated the findings in literature (Lakurbe *et al.*, 2018) who reported improved FCR in broiler chickens fed boiled soya bean meal compared to birds fed diets with LGNC and IGNC. FCR is an index of efficient

conversion of feed to flesh. From this study, findings reveal that less feed was required to gain 1kg of meat in birds fed steamed and toasted soya bean meal at comparative level to sun dried soya bean meal and groundnut cake. This poor performance of birds on GNC could be attributed to Sub-optimal amount of cysteine and methionine in its amino acid profile (Babawuro and Muhammed, 2018).

Table 2: Effect of Differently Processed Soya Bean Meal And Groundnut Cake Inclusion on Growth Performance of Starter Broiler Chickens (0 - 4 weeks)

Test ingredients Parameters	T1 SDSBM	T2 SSBM	T3 TSBM	T4 IGNC	T5 LGNC	SEM
Initial weight (g)	40.12	40.07	40.06	40.08	40.07	0.01
Final Weight (g)	744.25 ^c	942.50 ^a	840.25 ^b	745.00 ^c	681.25 ^c	22.35
Total weight gain (g)	704.13 ^c	902.43 ^a	800.19 ^b	704.93 ^c	641.18 ^c	18.27
Daily weight gain (g)	25.14 ^c	32.23 ^a	28.56 ^b	25.17 ^c	22.90 ^c	0.79
Total feed intake (g)	1010.62 ^b	1202.13 ^a	1104.20 ^b	1019.62 ^{bc}	973.21 ^c	3.72
Daily feed intake (g)	36.09 ^c	42.93 ^a	39.44 ^b	36.41 ^{bc}	34.75 ^c	1.12
Feed conversion ratio	1.43 ^b	1.33 ^c	1.38 ^c	1.45 ^b	1.52 ^a	0.06

^{abc} Mean on the same row having different superscripts were significantly ($P < 0.05$) different.

SDSBM = Sun Dried Soya Bean Meal, **SSBM** = Steamed Soya Bean Meal, **TSBM** = Toasted Soya Bean Meal, **IGC** = Industrial Groundnut Cake, **LGNC** = Local Groundnut Cake

Hematological Parameters

The result of hematological parameters of starter broiler chickens fed diet containing differently processed soya bean and groundnut cake is presented in Table 3. The results revealed significant ($P < 0.05$) influence on Mean corpuscular Haemoglobin concentration (MCHC), mean cell haemoglobin (MCH) and mean cell volume (MCV). Least significant ($P < 0.05$) value of 48.87g/dl was recorded for MCHC in the birds fed diet containing industrial groundnut cake (IGNC) at comparative level across dietary treatments. Though not statistically different, higher numerical value of 58.13g/dl was recorded for MCHC in the birds fed local groundnut cake (LGNC). Birds fed diet containing SDSBM and SSBM revealed similar statistical values of 112.00pg and 113.00pg for MCH. Birds fed toasted soya bean meal (TSBM) T3 showed least significant value of 100.67pg for MCH. Significant ranged values 46.87 - 58.13 g/dl obtained for MCHC in this study were higher than the mean value of 33.20 g/dl reported by Owosibo *et al.* (2017) when broiler chickens were fed corn bran meal supplemented with enzyme. Similar observations were made

for MCH and MCV. This observation may suggest that there was no negative interaction of energy and protein level in the dietary treatments. Thus the diets were nutritionally balanced with the inclusion of the test ingredients. Least significant ($P < 0.05$) value 40.00fl was obtained for MCV in birds fed diet containing IGNC. Ranged values of 40.00-51.00fl recorded for MCV in this study were lower than 93.22 fl reported for broiler chicken (Owosibo *et al.*, 2017).

Packed cell volume (PCV), white blood cell (WBC), haemoglobin (Hb), and red blood cell (RBC) were not significantly ($P > 0.05$) influenced by dietary treatments. Though not significantly influenced, range numerical values 25.00 - 26.33% recorded for PCV in this study fall within the range of 24.00% - 28.00% reported for broiler chickens (Onimisi *et al.*, 2017). Values recorded for PCV as reported in this study could be an indication that the bone marrow of the birds is functioned properly and showing the absence hypochronic anemia. PCV is a descriptor of the function and concentration of red blood cell (Kennedy, 2011).

Ranged values 2.40 – 2.60 $10^{12}/L$ recorded for red blood cell in this study favourably compared with the values 2.10 – 2.36 $10^{12}/L$ reported for

broiler chickens in literature (Oguntoye *et al.*, 2018)

Table 3: Effect of Differently Processed Soya Bean Meal and Groundnut Cake on Hematological Parameters of Starter Broiler Chickens (4 Weeks)

Test ingredients Parameters	T1 SDSBM	T2 SSBM	T3 TSBM	T4 IGNC	T5 LGNC	SEM
PCV (%)	25.67	25.66	25.00	26.33	26.00	0.49
White blood cell($10^9/L$)	12.33	12.73	11.60	11.27	11.73	0.25
Haemoglobin (g/dl)	66.46	46.00	48.07	49.37	45.33	3.00
Red blood cell ($10^{12}/L$)	2.48	2.40	2.41	2.60	2.43	0.07
Mean cell haemoglobin concentration (g/dl)	54.00 ^{ab}	51.00 ^{ab}	50.33 ^{ab}	48.87 ^b	58.13 ^a	1.09
Mean corpuscular haemoglobin (pg)	112.00 ^{ab}	113.00 ^a	100.67 ^c	106.67 ^{abc}	102.67 ^{bc}	1.56
Mean cell volume (fl)	49.57 ^{ab}	51.00 ^a	46.53 ^{ab}	40.00 ^b	47.67 ^{ab}	1.31

^{abc} Mean on the same row having different superscripts were significantly ($P < 0.05$) different.

SDSBM = Sun Dried Soya Bean Meal, **SSBM**= Steamed Soya Bean Meal, **TSBM** = Toasted Soya Bean Meal, **IGC** =Industrial Groundnut Cake, **LGNC** = Local Groundnut Cake

Serum Biochemical Indices

The result of serum biochemical indices of starter broiler chickens fed diets containing differently processed soya and groundnut cake is presented in Table 4. Dietary treatments had no significant ($P > 0.05$) effect on parameters determined. Values recorded for total protein showed no definite pattern across dietary treatments. Close range values 33.10 – 40.47 g/l was recorded for total protein across dietary treatments. Albumin and globulin followed similar trend with total protein. Improved numerical values obtained for total protein, albumin and globulin as revealed in this study

suggested adequacy of the diets in supplying protein needed by the birds. Total serum protein had been reported to depend on quality and quantity of protein supplied in the diet (Awosanya *et al.*, 1999).

Numerical values 2.50 - 3.87mmol/L recorded for uric acid in this study fall within the normal range reported in literature which indicated that no impairment in the balance of amino acid. Elevated uric acid is an indication of in balance of amino acid in the diet and consequently energy wastage (Nworgu *et al.*, 2007). Amino acids are required as a major precursor for biosynthesis of protein.

Table 4: Effect of Differently Processed Soya Bean Meal and Groundnut Cake on Serum Biochemical Indices of Starter Broiler Chickens (4 Weeks)

Test ingredients Parameters	T1 SDSBM	T2 SSBM	T3 TSBM	T4 IGNC	T5 LGNC	SEM
Total protein (g/dl)	37.00	32.40	36.13	33.10	40.47	1.91
Albumin (g/dl)	13.67	11.07	13.33	11.87	16.00	0.64
Globulin (g/dl)	23.33	21.33	22.80	21.23	24.47	0.59
Glucose (mmol/l)	1.93	1.80	1.80	1.77	2.20	0.07
Creatinine (mg/dl)	8.80	10.07	11.47	10.07	10.13	0.35
Uric acid (mg/dl)	3.87	2.63	3.13	2.50	3.57	0.26

^{abc} Mean on the same row having different superscripts were significantly ($P < 0.05$) different.

SDSBM = Sun Dried Soya Bean Meal, **SSBM**= Steamed Soya Bean Meal, **TSBM** = Toasted Soya Bean Meal, **IGC** =Industrial Groundnut Cake, **LGNC** = Local Groundnut Cake

CONCLUSION

The study revealed that differently processed full fat soybean meal and groundnut cake had no hazardous effect on starter broiler chicks. Steamed soya bean meal inclusion in diets of starter broiler chicken resulted in highest growth performance and feed efficiency and thus recommended. Further study should be carried out to ascertain optimum steaming temperature and duration for efficient broiler production.

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