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Performance, Hematology and Serum Biochemical Indices of Broiler Chickens Fed Toasted Sesame Seed (*Sesamum indicum, Linn*) Meal Based-Diets

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Authors' contributions

This work was carried out in collaboration between all authors. Authors OAO and ABO initiated, designed and wrote the protocol. Author APO collected data on broiler, undertook laboratory and statistical analyses. He also wrote the first draft of the manuscript while authors OAO and BCM managed the literature searches, wrote and edited the final manuscript. All authors read and approved the final manuscript.

Original Research Article

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ABSTRACT

Soyabean, one of the main ingredients commonly employed as a source of vegetable protein in broiler diets is expensive and may sometimes be unavailable. Thus, there is the need to assess the utilization of other legumes in broiler diets. Therefore, effects of dietary toasted sesame seed meal (TSSM) on growth, hematological and selected serum biochemical indices of broiler chickens was evaluated in a feeding experiment lasting 56 days. One hundred and eighty 1-day old Arbor acre chicks (39.2±0.15g/chicken) were randomly divided into five treatments. Each treatment was in triplicate of twelve birds per replicate. Graded TSSM was included at the expense of full fat soybean meal in the basal starter and finishers broiler rations viz; 0 (T1), 25 (T2), 50 (T3), 75 (T4) and 100% (T5). The diets and water were offered to respective birds *ad libitum*. The design of the experiment was a completely randomized design. Feed intake, weight gain and final weights of birds were significantly reduced ($p<0.05$) across treatments by increased dietary inclusion of TSSM while feed conversion ratio of birds increased significantly with increasing dietary TSSM ($P < 0.05$). Also, the packed cell volume (PCV), hemoglobin (Hb) and white blood cell (WBC) varied significantly ($P < 0.05$) with TSSM inclusion. However, the red blood cell

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(RBC), heterophils, lymphocytes, monocytes and eosinophils were not affected (P > 0.05) by the graded TSSM in the diets. Serum total protein, alanine amino transferase (ALT), alkaline phosphatase (ALP), cholesterol, triglycerides and very low density lipoprotein (VLDL) were also significantly different (P < 0.05) among treatments with no trial effect (P > 0.05) on serum albumin, creatinine, high density lipoprotein and aspartate amino transferase (AST). Conclusively, beneficial effects of dietary toasted sesame seed based diets on performance, haematology and biochemical indices of broiler chickens were obvious up to 25% levels of inclusion.

Keywords: Broiler serum lipids; toasted sesame seed diets; benniseed for chickens feeding; blood profile.

1. INTRODUCTION

Supply of dietary protein (essential amino acids) in the right quality and quantity remained the biggest problem facing small scale broiler chicken producers in developing countries [1]. Proteins of legumes, a conventional plant protein source for poultry feed formulation, are of high nutritional value but deficient in the first three limiting amino acids [2]. The synthetic amino acids commonly used in supplementing legume based-diets are found only in urban areas and are not always accessible for needed rural farming [3]. Available reference [4] indicated the dearth of these synthetic amino acids in rural settings. Therefore, the rural poultry farmers are sometimes left with no option other than to deprive their stocks the intake of essential nutrients.

Sesame seed (*Sesamum indicum*) is an old cultivated crop and thought to have originated in Africa. Its fruit is an oblong, mucronate, pubescent capsule containing numerous small, oval, yellow, white, red, brown or black seeds. It is also considered as one of the major world oil crop grown by small farmers in developing countries [5].

Sesame seed (benniseed) is produced locally in Nigeria and it is a good source of proteins with appreciable amount of methionine [6]. Sesame seed is rich in leucine, arginine and methionine, but relatively low in lysine compared to soybean. When used in the right proportions together with soybean meal which has higher content of lysine; more balanced rations with respect to lysine and methionine resulted [2]. However, as with most tropical legumes, sesame seed contain anti-nutritional factors, which may reduce its nutritive value in poultry feed [6,7]. Chief of these anti nutrients is phytic acid which has been reported to be appreciably eliminated when subjected to heat [8].

Sesame meal is an excellent source of protein. It was reported to contain crude protein (CP) levels of 47.1% (9) to 52.9% [10] and has amino acid composition similar to that of soybean meal. It can partially replace soybean meal in the diet as a source of plant protein for chicks [11], broiler and laying hen [9]. It has been reported [12] that sesame meal could be used to substitute soybean meal at 25% in broiler diet.

The ingestion of dietary components has measurable effects on blood constituents [13]. Although nutrient levels in the blood and body fluids are not valid indications of nutrient function at cellular level, they are considered to be proximate measures of long term nutritional status [14].

The dependence of blood protein and creatinine on the quality of dietary protein has been reported [15], while feeding swine with cassava leaf supplement led to a significant reduction in ALT and AST with a significant increase in serum total protein [16]. Hematological values are widely used to determine systemic relationship and physiological or pathological adaptations including the evaluation of general health condition, diagnosis and prognosis of various types of animals' diseases [17].

The present study was designed to evaluate the effects of inclusion of graded levels of toasted sesame seed on performance, haematology and serum indices of broiler chickens.

2. MATERIALS AND METHODS

One hundred and eighty 1-day old Arbor acre chicks with average weight of 39.2±0.15g were randomly divided into five treatments. Each treatment was in triplicate of twelve birds per replicate. The toasted sesame seed was included at graded levels viz; 0 (T1), 25 (T2), 50 (T3), 75 (T4) and 100% (T5) to replace full fat soybean meal in broiler diets. The diets and water were offered to birds *ad libitum*. Details of the experimental broiler starter and finishers diets formulation are shown in Tables 1 and 2. Samples of formulated feed and the test samples (Sesame seed) were analyzed chemically [18].

Feed intake for a replicate group was estimated on weekly basis by subtracting the weight of feed left over at the end of the week from the total weight of the feed offered during the week. This was further divided by the number of days in a week (7 days) after appropriate correction for mortality to obtain the average feed intake per bird per day. Daily feed intake estimation was pooled for the total experimental days to arrive at the average total feed intake of birds.

The weight of birds was recorded weekly. The weight gained by birds was estimated by deducting the previous weight from obtained weight at the end of the week. Feed conversion ratio (FCR) was calculated based on the formula:

FCR = Average feed intake/Average body weight gain

2.1 Blood Collection

Blood samples with or without anti-coagulant (EDTA) were obtained from the jugular vein of two birds per replicate at day 56. Blood samples collected with EDTA were used for hematological analyses while those collected without anti-coagulant were allowed to clot and the serum separated for biochemical analyses. Packed cell volume (PCV) and hemoglobin were determined using micro-hematocrit method and met-hemoglobin method as described [19]. RBC and WBC were also determined [20] The AST and ALT were estimated [21]. The determination of total protein [22] albumin [23] Serum cholesterol [24], triglycerides [25], ALP and HDL [26] were undertaken. The design of the experiment was a completely randomized design.

2.2 Statistical Analyses

Data were subjected to analysis of variance (ANOVA) using SAS [27] while significant means were separated with Duncan option of the same software. Selected performance parameters were also fitted into simple linear regression model to predict the relationships

between measured variables. The regression model was Y= a + bx where Y= Dependent variable, a= intercept on y axis, b= Regression coefficient and X= independent variable.

Table 1. Composition (g/100g Dry Matter) of graded toasted sesame seed based broiler starter experimental diets

Ingredients	T1	T2	T3	T4	T5
Maize	43.00	43.00	43.00	43.00	43.00
Full fat soybean meal	40.00	30.00	20.00	10.00	-
Sesame seed (Toasted)	-	12.80	25.60	38.40	51.20
Fish meal (72% CP)	2.00	2.00	2.00	2.00	2.00
Wheat bran	8.80	6.50	4.70	2.40	0.60
Oil	3.00	2.50	1.50	1.00	-
Dicalcium phosphate	1.50	1.50	1.50	1.50	1.50
Oyster shell	1.00	1.00	1.00	1.00	1.00
*Vitamin-mineral premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
L Lysine	0.10	0.10	0.10	0.10	0.10
DL methionine	0.10	0.10	0.10	0.10	0.10
Total	100	100	100	100	100

*T1= 0% toasted sesame seed, T2= 25% toasted sesame seed, T3= 50% toasted sesame seed, T4= 75% toasted sesame seed, T5 = 100% toasted sesame seed *1kg of Premix Contains Vitamin A-10,000,000 IU; Vitamin D3-2,000,000; Vitamin E-20,000 IU ;Vitamin K-2,250mg; Thiamine B1-1,750mg; Riboflavin B2- 5,000mg; Pyridoxine B6- 2,750mg; Niacin-27,500mg; Vitamin B12-15mg; Pantothenic acid- 7,500mg; Folic acid-7500mg; Biotin-50mg; Choline chloride-400g; Antioxidant-125g; Magnesium-80g; Zinc-50mg; Iron-20g; Copper-5g; Iodine-1.2g; Selenium-200mg; Cobalt-200mg.*

Table 2. Composition (g/100g Dry Matter) of toasted sesame seed based broiler finishers experimental diets

Ingredients	T1	T2	T3	T4	T5
Maize	45.00	45.00	45.00	45.00	45.00
Full fat soybean meal	35.00	26.25	17.50	8.75	-
Sesame seed (Toasted)	-	11.2	22.40	33.60	44.80
Fish meal (72% CP)	1.00	1.00	1.00	1.00	1.00
Wheat bran	12.80	10.85	9.40	7.45	6.00
Oil	3.00	2.5	1.5	1.0	-
Dicalcium phosphate	1.50	1.50	1.50	1.50	1.50
Oyster shell	1.00	1.00	1.00	1.00	1.00
*Vitamin-mineral premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
L Lysine	0.10	0.10	0.10	0.10	0.10
DL methionine	0.10	0.10	0.10	0.10	0.10
Total	100	100	100	100	100

*T1= 0% toasted sesame seed, T2= 25% toasted sesame seed, T3= 50% toasted sesame seed, T4= 75% toasted sesame seed, T5 = 100% toasted sesame seed *1kg of Premix Contains Vitamin A-10,000,000 IU; Vitamin D3-2,000,000; Vitamin E-20,000 IU ;Vitamin K-2,250mg; Thiamine B1-1,750mg; Riboflavin B2- 5,000mg; Pyridoxine B6- 2,750mg; Niacin-27,500mg; Vitamin B12-15mg; Pantothenic acid- 7,500mg; Folic acid-7500mg; Biotin-50mg; Choline chloride-400g; Antioxidant-125g; Magnesium-80g; Zinc-50mg; Iron-20g; Copper-5g; Iodine-1.2g; Selenium-200mg; Cobalt-200mg*

3. RESULTS AND DISCUSSION

The Proximate composition (g/100g Dry matter) of TSSM based broiler diets is presented in Table 3. The CP, CF and NFE fractions reduced while the EE component increased with increase inclusion of TSSM in both the starter and the finishers' diets. The chemical composition (g/100gDM) of sesame seed is presented in Table 4. The components indicated that sesame seed contains appreciable levels of anti nutritional constituents and phytochemicals like saponins (3.3mg/100g), Tannins (9.9mg/100g), oxalates (15.8mg/100g), Phytates (22.8mg/100g).

Table 3. Proximate composition (g/100g Dry matter) of toasted sesame seed based broiler experimental diets

Parameters	T1	T2	T3	T4	T5
Broiler Starter Diets					
Crude protein	23.31	22.94	22.65	22.28	21.99
Ash	7.00	7.30	7.80	7.75	5.40
Ether extracts	12.00	14.80	16.40	22.70	45.60
Crude fibre	7.70	7.30	6.80	6.90	4.00
Nitrogen free extracts (NFE)	49.99	47.66	46.35	40.32	23.01
Broiler Finishers Diets					
Crude protein	19.50	19.46	18.87	18.72	18.65
Ash	3.60	4.00	4.20	4.50	5.50
Ether extracts	11.40	13.90	16.00	19.20	37.50
Crude fibre	3.70	4.00	4.20	4.50	5.50
Nitrogen free extracts (NFE)	61.8	58.64	56.73	53.08	33.35

T1= 0% toasted sesame seed, T2= 25% toasted sesame seed, T3= 50% toasted sesame seed, T4= 75% toasted sesame seed, T5 = 100% toasted sesame seed

Table 4. Chemical composition (g/100gDM) of sesame seed

Parameters	Sesame seed
Moisture content	9.8
Crude protein	14.4
Ether extracts	27.3
Ash	7.9
Crude fibre	6.7
Nitrogen free extracts	43.1
Carbohydrates	23.9
Saponins (mg/100g)	3.3
Tannins (mg/100g)	9.9
Oxalates (mg/100g)	15.8
Phytates (mg/100g)	22.8
*Metabolizable energy (Kcal/Kg)	3751

** Calculated Metabolizable energy (ME = 432+ 27.91 (CP+ NFE+2.25xEE) (28)*

The performance, hematological and serum biochemical indices of broiler birds fed TSSM are presented in Tables 5, 6 and 7. There were significant variations ($P < 0.05$) in performance indices measured. Feed intake decreased across the dietary treatments. The differences in the rate of feed intake as shown in the various treatments indicated that the TSSM was not acceptable in the diets due to its bitter taste and high amount of oil [29]. It

could also be attributed to the anti-nutritional factors contained in the seed as earlier remarked [6,8].

As shown in Fig. 1, body weight gain of birds was linearly negatively correlated with increasing TSSM dietary inclusion. The overall regression equation; y=-14.111x+ 1703 (R^2=0.95). Diets T1 and T2 had similar effect (P > 0.05) on weight gain of the birds. This was in line with earlier document [12]. Birds on T5 which contained predominant level of TSSM recorded lower weight gain (283g). This was due to the corresponding lowered feed intake probably due to residual anti- nutritional factors in the seed [6,7]. Results of final weight decrease across dietary treatments were attributed to lowered feed intake of birds.

Feed conversion ratio (FCR) is an important index of performance which is a direct indication of how best feed offered to birds was utilized for meat production. The lower the FCR value, the better the feed utilization, birds with higher FCR value had suppressed growth. The FCR increased across dietary treatments which was in line with the earlier report (10) for broilers fed sesame seed meal. This study revealed that birds on control diet (2.27) utilized nutrients similarly (P<0.05) with those on T2 (2.36) which however varied significantly (P<0.05) when compared with those on T3 (2.65), T4 (2.74) and T5 (3.10). In Fig. 2, regression of graded levels TSSM on FCR was linearly positive. The overall regression equation; y= 0.0081+2.218 (R^2= 0.729) revealed that increased inclusion of TSSM would progressively reduce the efficiency of TSSM based diets and that 22% dietary toasted sesame seed meal would result in FCR value of 2.22.

The hematological indices of broiler birds are presented in Table 6. There were significant variations (P < 0.05) in the values of PCV, Hb and WBC among dietary treatments. The PCV level is one of the indicators suggestive of the presence of toxic factor that adversely affects blood formation [19]. The PCV values obtained from this study were within the standard range of 22-35% [20] for healthy chickens except for those birds on diet T5 (19.67%) which fed on diet that contained highest level of TSSM. This may therefore be indicative of the effect of anti nutritional factors in the seed. Hematological indices especially PCV and Hb have been earlier correlated with nutritional status of animals [29,30].

Table 5. Performance of broilers fed graded toasted sesame seed based diets (0- 8 weeks)

Parameters	T1	T2	T3	T4	T5	SEM
Initial weight (g)	39.20^{a}	39.20^{a}	39.20^{a}	39.20^{a}	39.20^{a}	0.15
Final weight(g)	1688.90^{a}	1500.03^{a}	966.67^{b}	705.70^{c}	322.20^{d}	38.74
Weight gain(g)	1649.70^{a}	1460.83^{a}	927.47^{b}	666.50^{c}	283.00^{d}	38.74
Feed intake (g)	3708.90^{a}	3430.83^{b}	2458.93^{c}	1822.77^{d}	871.17^{e}	18.06
FCR	2.27^{c}	2.36^{bc}	2.65^{b}	2.74^{ab}	3.10^{a}	0.07

Means with different superscripts on the same row are significantly different (P < 0.05).
FCR- feed conversion ratio, SEM- Standard error of means; T1= 0% toasted sesame seed, T2= 25% toasted sesame seed, T3= 50% toasted sesame seed, T4= 75% toasted sesame seed, T5 = 100% toasted sesame seed

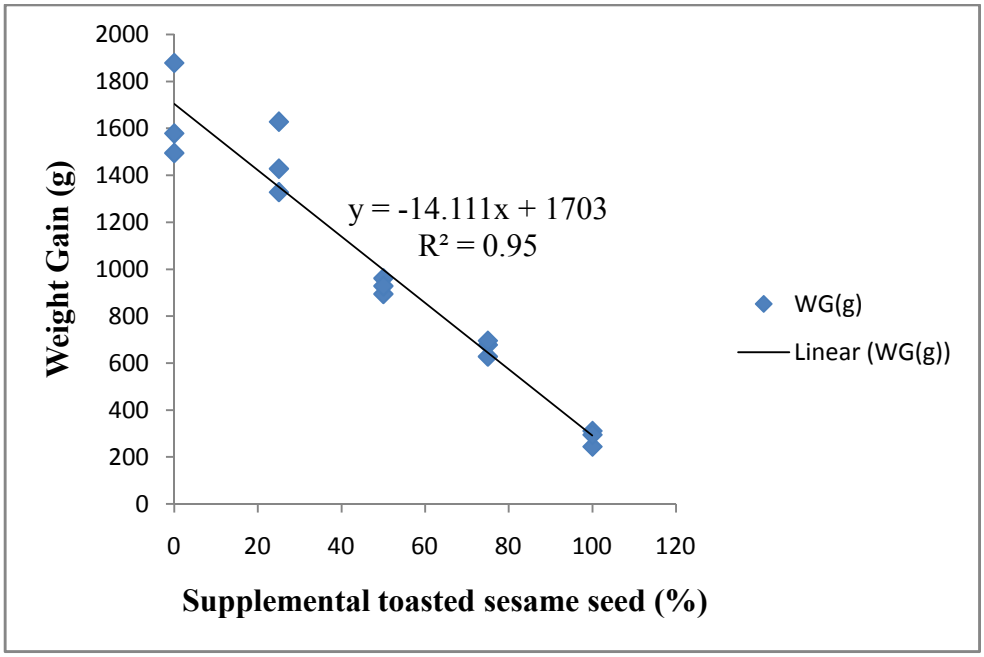

Fig. 1. Relationship between supplemental graded toasted sesame seed and weight gain of broilers fed experimental diets

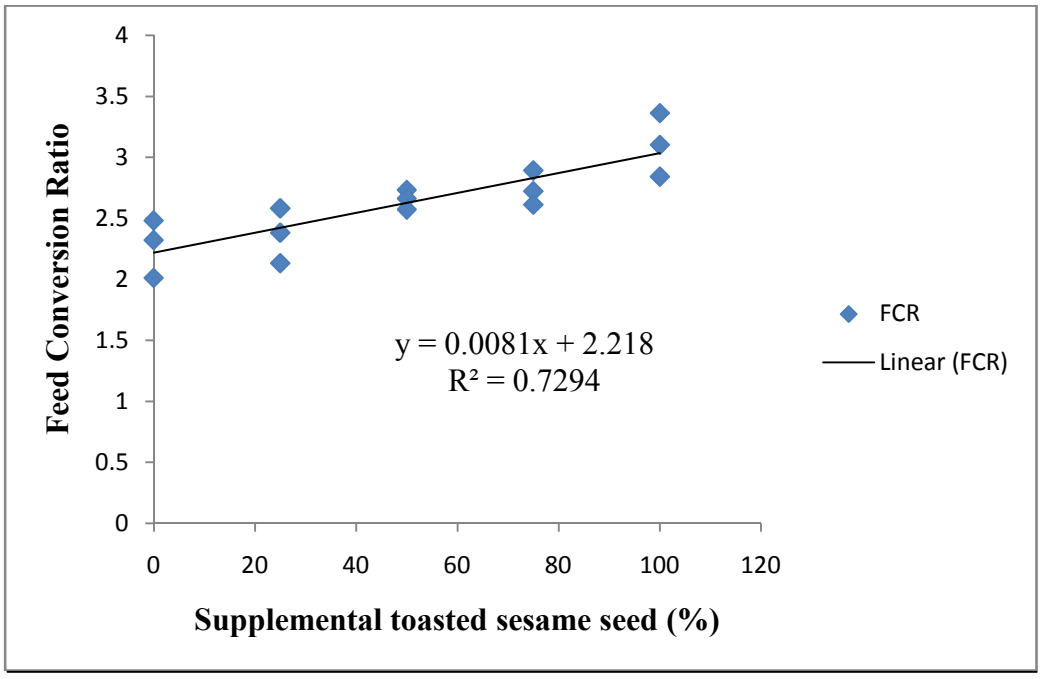

Fig. 2. Relationship between supplemental graded toasted sesame seed and feed conversion ratio of broilers fed experimental diets

The red pigment of the erythrocyte functions in the transport of oxygen and carbon (IV) oxide in animal body. Results for Hb was therefore indicative of variations in oxygen and carbon (IV) oxide carrying capacity of birds fed graded levels of TSSM based diets. The values were within the standard range of 7-13g/dl [19]. There was a general progressive decrease in the value with the increasing inclusion of TSSM. However, value recorded for birds on T5 (6.55g/dl) could be as a result of high dietary energy as earlier reported [31]. Birds on T2 had higher values for both PCV (29%) and Hb (9.66g/dl). This showed that the diet contained relatively higher quality protein that met both the birds' protein requirement as well as favored the health status. However, regression of both the Hb and PCV on graded TSSM diets are shown in Figs. 3 and 4 respectively. There were negatively linear relationships of both indices with dietary TSSM and the overall regression equations were Hb= -0.0351x+10.707 (R2= 0.6721) and PCV= -0.1093x+32.133 (R2= 0.7341) respectively.

In this study, the values obtained for WBC of birds were within the reference range of 9-31x103/mm3 [21] for healthy birds. Decreased WBC below the normal range is an indication of allergic conditions, anaphylactic shock and certain parasitism or presence of foreign body in circulating system [24,25]. Birds on diets T1, T2 and T5 had similar ($P > 0.05$) values which revealed that the effect of diets were similar on the birds.

The values obtained for the blood differential counts; heterophils, lymphocytes, monocytes and eosinophils for birds on diets T1, T2, T3, T4 and T5 respectively indicated that graded dietary TSSM had no influence on these indices ($P > 0.05$).

Red blood cell values obtained in this study did not vary significantly ($P > 0.05$). This showed that graded dietary TSSM had no influence on RBC of birds and it revealed that the birds were not anemic.

Table 6. Hematology of broilers fed graded toasted sesame seed based diets

Parameters	T1	T2	T3	T4	T5	SEM
PCV (%)	32.00^{c}	29.00^{bc}	26.33^{b}	26.33^{b}	19.67^{a}	1.37
Hb (g/dl)	10.66^{c}	9.66^{bc}	8.78^{b}	8.77^{b}	6.55^{a}	0.45
RBC ($x10^{6}/mm^{3}$)	3.66^{a}	4.00^{a}	4.27^{a}	3.50^{a}	4.23^{a}	0.25
WBC ($x10^{3}/mm^{3}$)	23.25^{ab}	22.60^{ab}	24.72^{b}	17.67^{a}	23.25^{ab}	1.69
Heterophils (%)	34.33^{a}	31.67^{a}	39.33^{a}	33.67^{a}	39.00^{a}	5.72
Lymphocytes (%)	61.67^{a}	65.33^{a}	56.33^{a}	62.67^{a}	57.67^{a}	5.75
Monocytes (%)	1.33^{a}	0.67^{a}	0.67^{a}	1.33^{a}	1.00^{a}	0.39
Eosinophils (%)	3.00^{a}	2.67^{a}	3.67^{a}	2.33^{a}	2.33^{a}	1.01
Basophils (%)	0.00	0.00	0.00	0.00	0.00	0.00

Means with different superscripts on the same row are significantly different ($P < 0.05$). SEM- Standard error of means PCV- Packed cell volume, RBC- Red blood cell, Hb- Hemoglobin, WBC- White blood cell. T1= 0% toasted sesame seed, T2= 25% toasted sesame seed, T3= 50% toasted sesame seed, T4= 75% toasted sesame seed, T5 = 100% toasted sesame seed.

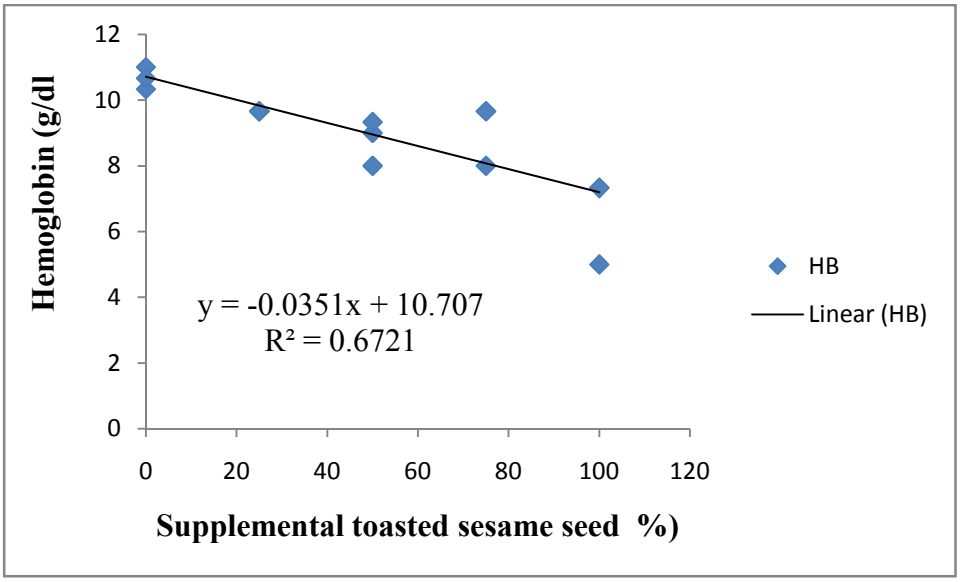

Fig. 3. Relationship between supplemental graded toasted sesame seed and hemoglobin of broilers fed experimental diets

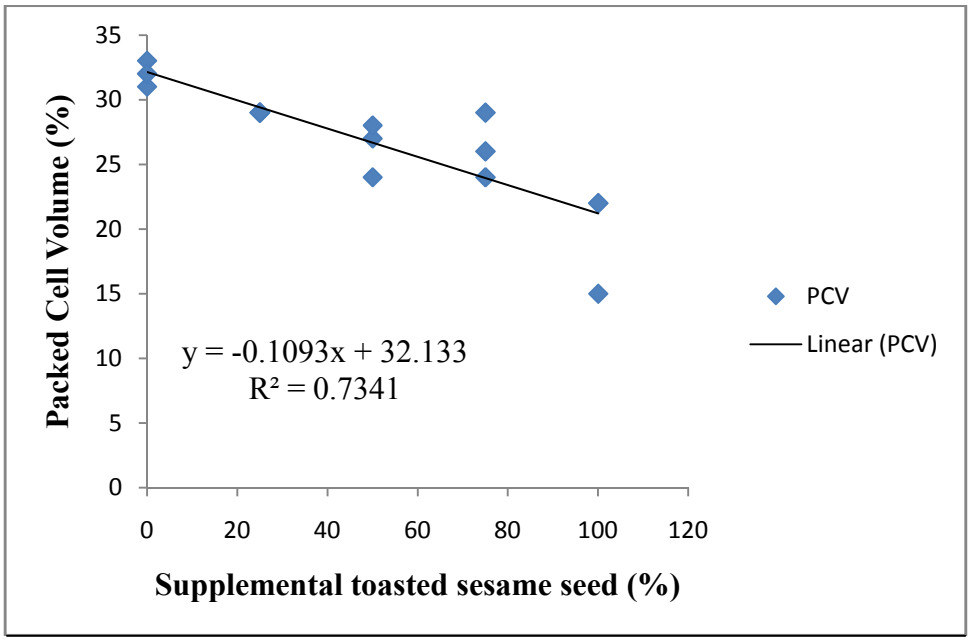

Fig. 4. Relationship between supplemental graded toasted sesame seed and packed cell volume of broilers fed experimental diets

Serum biochemical indices of broiler chickens fed graded dietary TSSM are presented in Table 7 There were significant differences ($P < 0.05$) in the values of total protein, ALT, ALP, cholesterol, triglycerides and VLDL among dietary treatments. The recorded variations in serum total protein stemmed from the different rate of protein metabolism and utilization by

the birds. The values obtained were in line with earlier observation for rabbits using same test ingredient [32]. Birds on T2 had higher serum total protein value (4.02). This indicated that the diet was relatively of good quality and that birds on T2 were more efficient in protein metabolism and utilization. Birds on diets T3, T4 and T5 showed similar variations ($P > 0.05$). This revealed that the rate of protein metabolism and utilization were similar.

Values of ALT obtained for birds on T1 and T3 as well as T4 and T5 were similar ($P > 0.05$) which revealed that livers of birds' on these diets were functioning similarly The values of ALP are indicative of liver functioning and also the rate of bone mineralization of broiler chickens. The significantly different ($P < 0.05$) ALP values could be attributed to varying dietary phosphorus in the feed or its utilization as affected by phytate content of TSSM as earlier reported [7,33].

Cholesterol (mg/dL) increased significantly ($P < 0.05$) from 111.84 in birds on control to 166.77 in birds on T5 which conformed to similar report on the capability of dietary sesame to increase serum cholesterol [34]. As shown in Fig. 5, regression of serum cholesterol (mg/dL) on graded supplemental TSSM was positive; $y= 0.6527x+110.2$, ($R^2 = 0.47$). Sesame seed is reported to contain lignans that lowers total blood cholesterol [35] Also, the presence of saponins in TSSM might interfere with the absorption of dietary lipids and cholesterol resulting in overall cholesterol-lowering effect [36] which however was contrary to results of high blood cholesterol concentration with increasing TSSM from this study.

Table 7. Selected biochemical indices of broilers fed graded toasted sesame seed based diets

Parameters	T1	T2	T3	T4	T5	SEM
Total protein (g/dl)	2.56^{a}	4.02^{b}	3.51^{ab}	3.12^{ab}	3.06^{ab}	0.34
Albumin (g/dl)	1.48^{a}	1.79^{a}	1.74^{a}	2.07^{a}	1.85^{a}	0.20
Urea (mg/dl)	1.77^{a}	1.72^{a}	2.94^{a}	2.18^{a}	3.40^{a}	0.80
Creatinine (mg/dl)	0.77^{a}	0.71^{a}	0.77^{a}	0.64^{a}	0.50^{a}	0.15
AST (iu/l)	82.56^{a}	90.22^{a}	94.23^{a}	92.61^{a}	92.83^{a}	14.00
ALT (iu/l)	13.74^{ab}	17.22^{b}	11.89^{ab}	9.39^{a}	10.99^{a}	1.80
ALP (iu/l)	15.08^{a}	13.37^{a}	30.15^{b}	23.15^{ab}	30.76^{b}	3.32
Cholesterol (mg/dl)	111.84^{a}	115.72^{ab}	150.7^{ab}	169.03^{b}	166.77^{b}	16.27
Triglycerides (g/dl)	33.81^{a}	74.59^{b}	91.29^{bc}	94.09^{bc}	120.05^{c}	12.01
VLDL (mg/dl)	6.76^{a}	14.92^{b}	18.26^{bc}	18.82^{bc}	24.01^{c}	0.48
HDL (mg/dl)	59.62^{a}	60.84^{a}	78.11^{a}	58.44^{a}	59.60^{a}	2.40
Phosphorus (mg/dl)	3.03^{a}	3.61^{a}	3.25^{a}	3.31^{a}	3.20^{a}	7.49

Means with different superscripts on the same row are significantly different ($P < 0.05$).
SEM- Standard error of means AST- Aspartate amino transferase, ALT- Alanine amino transferase, ALP- Alkaline phosphatase, HLD- High density lipoprotein, VLDL- Very low density lipoprotein, T1= 0% toasted sesame seed, T2= 25% toasted sesame seed, T3= 50% toasted sesame seed, T4= 75% toasted sesame seed, T5 = 100%

Serum triglycerides increased ($P < 0.05$) progressively with higher inclusion of TSSM in the diets [31]. This indicated variations in triglycerides absorption and utilization among broiler chickens fed graded levels of TSSM based diets. Birds on diet T5 which contained predominant level of TSSM had higher value (120.05g/dl) which could be as a result of high amount of oil and calorie content of sesame seed as earlier documented [34].

The VLDL values in this study were within the normal documented range [37] of 2-30mg/dL for healthy birds. The variations ($P < 0.05$) indicated varied capacity of experimental birds in metabolizing and in transport of fat or lipids from livers to tissues. Birds on diets T3 and T4 had similar values ($P > 0.05$) which revealed similarity in the production potentials of VLDL by the livers. The serum urea, creatinine, AST, HLDL and phosphorus of birds on T1, T2, T3, T4 and T5 respectively were not significantly different ($P > 0.05$) which showed that the inclusion of graded dietary TSSM had no influence on these indices.

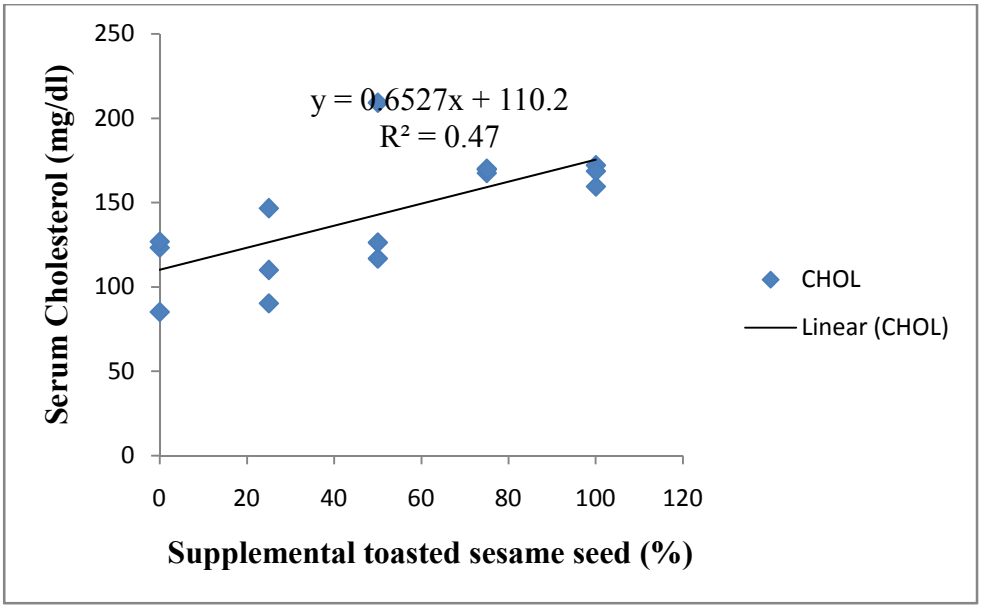

Fig. 5. Relationship between supplemental graded toasted sesame seed and serum cholesterol of broilers fed experimental toasted sesame seed diets

4. CONCLUSION

Toasted sesame seed could be incorporated up to 25% in the diets of broiler chickens without any adverse effect on performance, haematological parameters and serum biochemical indices. Toasting as a treatment method alone may not be adequate to remove the entire innate anti nutritional factors. Therefore, for maximum utilization of the embedded nutrients in sesame seed, the use of relevant additives alongside other treatments are hereby recommended.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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