



## Effects of Feeding Soaked-toasted Tallow (*Detarium microcarpum*, Guill and Sperr) Seed Meal as Replacement for Soybean Meal on Organ Weights, Haematology and Serum Biochemical Indices of Broiler Chickens

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### Authors' contributions

This work was carried out in collaboration between all authors. Authors COB and YTA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors PAS and ATJ managed the analyses of the study. Author BCL managed the literature searches. All authors read and approved the final manuscript.

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### ABSTRACT

The effect of feeding graded levels of soaked-toasted Tallow seed meal (STTSM) as partial replacement of soybean meal on the organ weights, haematological and biochemical indices of broiler chicks were evaluated. Three hundred and sixty (360) day- old broiler chicks of the Amo Strain were used. The experimental layout was a completely randomized design with three treatments, each with three replicates (40 birds/replicate). The inclusion levels of STTSM in the diets were 0, 10 and 20% (w/w). The parameters measured were live body weight, organ weights, haematological and biochemical indices. ANOVA showed that final body live weight was higher ( $P < 0.05$ ) in broilers fed the control diet (0% STTSM) compared to that fed with the STTSM formulated diets. The substitution of STTSM in broiler chick diets did not significantly affected the

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organ weights of liver (30-40 g), heart (8-10 g), kidney (2 g), pancreas (5-7 g), proventriculus (9-10 g) and gizzard (39-65 g). The fat deposit of birds fed with the 0% STTSM diet (65 g) was significantly ( $p < 0.05$ ) higher compared to that fed with the STTSM (39 g) based diets. The values of the haematological and biochemical indices were not affected ( $P > 0.05$ ) by the incorporation of STTSM in the diets. As it can be concluded, tallow seeds meal can be incorporated in broiler chickens rations up to 20% with no adverse effects on organ weights and haematological and biochemical indices of broiler chicks.

**Keywords:** Integrated treatment; tallow seeds; chickens; organs; haematology; biochemical indices.

## 1. INTRODUCTION

Nowadays, conventional sources of protein such as groundnut cake, soybean meal, fish meal and energy (maize) for monogastric animals are increasing in cost and scarce due to competition between man and livestock [1]. This fact has led to a renewed interest in the use of alternative, non-conventional, cheap and easily available ingredients of wild legumes in livestock feeding to meet future demand [2].

Tallow tree or Sweet dattock" tree (*Detarium microcarpum*) is a tropical legume plant which belongs to the family *Caesalpinoideae* and is located mostly in savannah zones with a high productivity yield of seeds embedded in the fruits [3,4,5]. Previous investigations on the proximate composition of *D. microcarpum* seed [6,7,8,9,10] have reported that it has a various content in crude protein (8.8-37.20%), crude fibre (1.1-5.6%), ash (1.5-3.2%), fat (1.5-14%) and carbohydrate (35-58%) with energy values of  $5.53 \text{ Kcalg}^{-1}$  [11], similar to that reported in soybean ( $5.52 \text{ Kcalg}^{-1}$ ) [12].

In contrast with the high nutritive and energy value of the seeds, anti-nutritional factors such as phytic acids, oxalate, saponin, tannin appear to affect performance parameters of animals [7,8]. Negative effects on performance of broilers were observed when they were fed single processed mucuna bean [13,14] and *D. microcarpum* seeds [9]. Integrated processing methods of legumes' seeds (soaking-cooking, cooking-fermentation and toasting-soaking) have been reported to eliminate the negative effects of anti-nutritional factors present in tropical raw legumes and other vegetable protein sources [14,15].

"Haematological, biochemical and enzymes parameters are indicators of metabolites and other constituents, which provide a valuable medium for assessment of health and nutritional status of animals [16], especially when they are

fed with toxic diets that affect the functionality of the organs and the transport of the molecules across organs [17]. This study was therefore designed to investigate the implications of feeding broiler chickens with soaked-toasted Tallow seed meal on organ weights, haematological and biochemical indices.

## 2. MATERIALS AND METHODS

### 2.1 Site of the Experiment

The study was carried out at Aga Livestock Farm Ltd, a commercial farm with standard building for Teaching and Research in Wukari Metropolis, Taraba State, Nigeria. Wukari is located between Latitude  $7^{\circ}51'N$ ,  $9^{\circ}47'E$  and Longitude  $7^{\circ}85'N$ ,  $9^{\circ}78'E$  [18].

### 2.2 Collection and Processing of Seed Meal

Dry Tallow fruits were collected from Wukari area in Taraba State. The fruits were mechanically opened to remove the seeds. The raw seeds were cleaned of dirt soaked in water at room temperature for one day (1 d), drained and rinsed once with fresh water and air-dried for three days. The dried seeds were poured into a frying pan mixed with sand in ratio 2:1 under control open fire. Turning was constantly done (to avoid the seeds burning off) until the white endosperm seed turns crispy brown in colour after 30-35 min [19]. The roasted seeds were decorticated and then ground to form soaked-toasted Tallow seed meal (STTSM)

### 2.3 Birds, Diets and Experimental Design

A total of 360 day-old unsexed broiler chicks (Amo) were purchased from a reputable Hatchery in Ibadan, Oyo State for this study. Birds were weighed and randomly assigned to three treatments. Each treatment had three replicates of 40 birds under a completely

randomized design. Three diets were formulated with tallow seed meal to replace soybean meal at 0, 10 and 20% inclusion levels (starter and finisher phases) (Table 1). The diets were formulated according to standard requirements recommended by Olomu [20]. The brooder house was thoroughly cleaned, washed, disinfected, allowed to rest for a week before the arrival of chicks and light provided using electricity and rechargeable lanterns to encourage the birds to eat in the night. Birds were fed starter diet for 28 day before switched over to finisher phase for 28 days. Feed and water were provided *ad libitum*. All management procedures were according to that described by Olomu [20]. The birds were weighed weekly and feed intake daily recorded for the estimation of the average daily weight gain and cumulative feed intake. The duration of the experiment was 56 days.

## 2.4 Data Collection

### 2.4.1 Organ weights

On the 56<sup>th</sup> day of the trial, five birds per replicate were randomly selected for organ weight evaluation after overnight fasting. The birds were weighed, slaughtered and allowed to bleed thoroughly before the carcasses were de-feathered, cleaned, dissected and eviscerated. The heart, pancreas, liver, kidney, proventriculus and gizzard were removed and weighed. The fat deposit was removed from around the rectum in the cloacal portion and from the gizzard with proventriculus in the keel portion and weighed.

### 2.4.2 Blood assay

Five (5) milliliters of blood was collected through wing vein from three birds per replicate by using a 24-gauge needle in separate screw-type tubes for obtaining plasma and serum. Each blood collection tube contained Ethylene Diaminetetra-acetic Acid (EDTA) as an anticoagulant for the study of various hematological parameters. The packed cell volume, red blood cells, haemoglobin, white blood cells and its differentials (lymphocytes, neutrophils, monocytes, basophils and eosinophils) were analyzed according to routine available clinical methods described by Bauer et al. [21]. Blood samples for serum biochemical studies were collected into plain vacutainers (i.e. without anticoagulant) for serum separation. Serum was obtained by centrifugation for 5 minutes at 2000 rpm. Blood biochemical parameters of total

protein (g/dL), glucose (mg/dL), urea (g/dL), (mg/dL), total cholesterol (mg/dL), calcium, sodium, magnesium, potassium, Aspartate aminotransaminase (AST) and Alanine aminotransaminase (ALT) activities were determined using commercial biodiagnostic kits and spectrophotometric methods as described by [22,23].

## 2.5 Proximate Analysis

Proximate composition of experimental diets was determined for moisture, crude protein, ash, fat and crude fibre according to AOAC [24].

## 2.6 Statistical Analysis

Data collected for all the parameters were subjected to analysis of variance (ANOVA) for completely randomized design (CRD) using the Statistical Package for Social Sciences (SPSS for windows), Version 20. Means were separated using Duncan Multiple Range Test [25].

## 3. RESULTS AND DISCUSSION

### 3.1 Live Weight and Organ Weights

The results of the live body and organ weights are shown in Table 2. The organ weights of broilers (liver, pancreas, proventriculus, kidney, heart and gizzard) were similar ( $p>0.05$ ) among the dietary treatment groups. The results for the abdominal fat deposits showed that birds on 0% soaked- toasted Tallow seed meal (STTSM) diet had significantly ( $p<0.05$ ) higher fat deposit compared to that of the birds fed with 10 or 20% STTSM based diets.

The decrease in the final live weight with the increasing levels of STTSM in the diets could be attributed to the poor nutrient utilization of STTSM based birds. The similar weights ( $p>0.05$ ) of organs (liver, heart, kidney, proventriculus, pancreas and gizzard) is an indication of healthy chicks, suggesting that soaked-toasted processing method may have rendered the anti-nutritional factors (ANFs) inactive as it can be hypothesized by no signs of inflammation observed in liver and pancreas. The similar weights of visceral organs observed in this study are in agreement with previous observations [15] where integrated processing methods (cooking and fermentation) render ANFs inactive and enhanced nutritive value. The resulted slight depressed organ weight of birds

(apart from heart) with increased STTSM based diets is in agreement with previous researchers [26,27] who stated that the live weight and the external surface area of birds determine the amount of feathers and visceral organs required. This result is in line with previous reports [28,29] where the similarity of liver, gizzard and heart weights reveals no adverse effects of the residual anti-nutritional factors. The breast and abdominal fat components of broilers are regarded as very important parts in assessing quality. Broilers with well developed breast meat are considered superior while high deposit of fat indicates poor finishing [30]. From the results of this study, broilers fed with a tallow seed meal based diet seem to have lower levels of fat compared to that fed full fat soybean based diets.

### 3.2 Haematological Indices of Experimental Birds

The results on Table 3 present the examined haematological indices of broiler chickens. Haematological indices of packed cell volume

(PCV), red blood cell (RBC), haemoglobin (Hb), white blood cell (WBC) and its differentials (lymphocytes, neutrophils, basophils, monocytes, eosinophils) were not significantly ( $P > 0.05$ ) different among the experimental groups.

The similarity ( $p > 0.05$ ) in haematological indices observed in this study were all within the normal range [31], a fact that indicates the better utilization of the nutritional sources. Haematological values could offer baseline information about the physiology and health status of farm animals [32]. The lack of discrepancy in the values of these parameters is an indication that the treatment of tallow soaking-roasting eliminates the toxic metabolites by rendering them inactive. The PCV values were within the normal range of 27 – 33% [33], which indicated that the birds were neither dehydrated nor anaemic. The RBC, WBC, and Hb values obtained in this study were within the normal range of  $2.5 - 3.2 \times 10^6 / \text{mm}^3$ ,  $9 - 31 \times 10^3 / \text{mm}^3$  and 6.5 – 11 g/dl, respectively [33,34].

**Table 1. Gross composition of experimental starter and finisher broiler chicks' diets**

Ingredients	% Dietary Starter Phase			% Dietary Finisher Phase		
	0%	10%	20%	0%	10%	20%
Maize	51.00	51.00	51.00	52.00	52.00	52.00
Maize bran	10.00	10.00	10.00	15.00	15.00	15.00
Soybean (Fullfat)	30.00	20.00	10.00	25.00	15.00	5.00
STTSM	0.00	10.00	20.00	0.00	10.00	20.00
Fish meal	3.00	3.00	3.00	3.00	3.00	3.00
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00
Lime stone	2.00	2.00	2.00	1.00	1.00	1.00
Methionine	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25	0.25
*Premix	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
<b>Calculated analysis</b>						
Crude protein	22.89	22.76	22.60	20.40	20.32	20.12
Crude fibre	4.20	4.40	4.70	5.00	4.63	4.60
ME (kcal/kg)	2876.00	2840.60	2832.31	2872.00	2860.00	2854.20
<b>Analyzed chemical composition</b>						
Crude protein	22.00	21.81	21.72	20.13	19.85	19.60
Crude fibre	4.58	4.00	4.20	4.63	4.80	4.94
Fat	4.70	4.56	4.30	4.43	4.36	4.20
Ash	3.41	3.30	3.50	3.32	3.60	3.61
Ca	1.76	1.70	1.68	1.36	1.40	1.42
p	0.60	0.62	0.60	0.60	0.62	0.61

\* To provide the following per Kg of feed: vit-A 100000 IU; vit. D<sub>3</sub>2000iu; vit. B;0.75 mg; nicotinic acid-25 mg; Ca, panthothenate- 12.50 mg; vit.B<sub>12</sub>2.5 mg; vit. K-2.5 mg; vitE-25 mg; Cobalt 0.4 mg Biotin-0.50 mg; Folic acid- 1 mg; Cholin chloride-25 mg; Cu-8.00 mg; Mg-64 mg; Fe-32 mg; Zn 4 mg; Iodine-0.80 mg; Flavomyacin-100 mg; Sapriomyin-5 mg; DI-methionine-50 mg; Selenium- 0.16 mg; 1-lysine 120 mg.

STTSM: Soaked-toasted Tallow seed meal

The PCV, Hb, and RBC levels of broiler chickens fed with the experimental diets were similar ( $P>0.05$ ), a finding that suggests absence of dysfunction in blood haemopoiesis. The differential lymphocytes, monocytes, eosinophils and basophils also showed no significant ( $P>0.05$ ) differences among the treatment groups, and the observed values were within the normal range [35]. This is an indication of adequate production of anti-bodies and no

bacterial or viral infection, since blood parameters could act as a pathological reflector of the status of exposed animals to toxicant and other conditions [36]. According to Egbunike et al. [37], changes in haematological parameters are often used to determine health status and monitor possible adverse effects due to environmental, nutritional and/or pathological factors.

**Table 2. Live weight and organ weights of finisher broiler chickens fed soaked-toasted tallow seed meal**

Parameters	0% STTSM	10% STTSM	20% STTSM	SEM
Mean live weights (g)	1866.67 <sup>a</sup>	1683.33 <sup>b</sup>	1633.33 <sup>b</sup>	62.36
Liver (g)	39.67	30.00	33.33	1.75
Heart (g)	9.00	8.33	10.00	0.77
Pancreas (g)	7.00	6.33	5.33	1.09
Proventriculus (g)	10.33	9.33	9.33	0.75
Gizzard (full)(g)	52.00	48.67	43.00	2.46
Kidney (g)	2.00	2.00	2.00	0.00
Fat deposit (g)	65.33 <sup>a</sup>	39.33 <sup>b</sup>	39.00 <sup>b</sup>	8.14

Mean within the same row bearing different superscripts differ significantly ( $P<0.05$ )

**Table 3. Haematological indices of birds fed diets containing soaked-toasted tallow seed meal**

Parameters	0% STTSM	10% STTSM	20% STTSM	SEM
PCV (%)	28.00	28.12	28.37	0.30
RBC ( $\text{mm}^3 \times 10^6$ )	2.73	2.74	2.73	0.03
Haemoglobin (g/100 ml)	11.00	11.00	10.67	0.10
WBC ( $\text{mm}^3 \times 10^3$ )	19.77	19.53	19.70	0.13
Lymphocytes, %	60.37	56.57	56.93	1.63
Neutrophils, %	43.00	43.47	43.67	0.47
Monocytes, %	6.10	6.43	6.86	0.29
Eosinophils, %	3.90	4.27	4.57	0.12
Basophils, %	1.33	1.00	0.67	0.72

Mean within the same row bearing different superscripts differ significantly ( $P<0.05$ )

PCV, Pack cell volume; RBC: Red blood cells; WBC: white Blood cells

**Table 4. Biochemical indices and serum electrolytes of experimental birds fed soaked-toasted tallow seed meal**

Parameters	0% STTSM	10% STTSM	20% STTSM	SEM
Serum total protein (g/100 ml)	3.67	3.73	3.43	0.17
Albumin (g/100 ml)	1.40	1.47	1.40	0.07
Urea (mmol/l)	2.67	2.67	2.70	0.14
Glucose (mg/100 ml)	160.50	154.17	160.73	3.19
Cholesterol (mg/100l)	116.83	112.73	110.97	5.17
Globulin (g/100 ml)	2.51	2.40	2.38	0.04
ALT ( $\mu\text{l}$ )	8.02	9.29	8.53	0.52
AST ( $\mu\text{l}$ )	13.01	13.87	12.87	0.41
Calcium Ca(mg/100 ml)	11.28	10.67	10.83	2.95
Sodium (Na) (mEq/l)	138.67	138.67	140.67	15.38
Potassium (K) (mEq)	5.21	4.53	4.77	1.3
Magnesium (Mg/100 ml)	1.94	1.74	1.91	0.09

Mean within the same row bearing different superscripts differ significantly ( $P<0.05$ )

STTSM: Soaked-Toasted Tallow seed meal, AST: Aspartate aminotransaminase; ALT: Alanine aminotransaminase

### 3.3 Biochemical Indices of Experimental Birds

The results of the biochemical indices are shown in Table 4. There were no significant differences ( $P>0.05$ ) among the treatment groups in serum total protein, albumin, glucose, urea, cholesterol; globulin, AST, ALT, calcium, magnesium, sodium and potassium of birds fed 10 or 20% of STTSM as replacement for soybean.

The lack of discrepancy in serum biochemical indices such as serum total protein, albumin, globulin, urea and glucose among the treatment groups despite the inclusion of STTSM suggests no negative effects on body systems and protein utilization by the birds [38]. The electrolytes and marker enzymes; Aspartate aminotransferase (AST) and Alanine aminotransferase (ALT) were not significantly affected by the STTSM dietary inclusion, indicating that the liver and the kidney were physiologically normal. The similarity ( $p>0.05$ ) in serum urea values among the treatment groups further suggest that there is no wasting or catabolism of muscle tissue and live cell damage as also reported by previous studies [29].

### 4. CONCLUSION

Partial replacement (10 or 20%) of soybean meal by soaked-toasted tallow seed meal in broiler diets appeared to depress the live weight and decrease fat deposit values but with no further adverse effect on organ weights and haematological and biochemical indices of broiler chicks. Soaked-toasted treatment therefore could serve as an effective method to improve the nutritional value of tallow seeds for poultry. Based on low fat deposit, tallow seed meal is a great protein source and can be utilized up to 20% in the diet to produce broiler chickens with high-quality carcass characteristics.

### ETHICAL CONSIDERATION

The study was conducted with permission from the Nigeria Institute of Animal Science welfare and ethics committee (Act No.26 Of 2007) in collaboration with the Department of Animal Production and Health, Federal University Wukari, Taraba State, Nigeria.

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### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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