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COMPARATIVE EVALUATION OF PARTIAL REPLACEMENT OF SOYBEAN MEAL WITH RAW AND OVEN-DRIED *CASSIA TORA* SEEDMEAL ON THE PERFORMANCE OF BROILER CHICKENS.

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ABSTRACT

This study was conducted to comparatively evaluate partial replacement of soybean meal with raw and oven-dried *Cassia tora* seed meal (CTSM) on the performance of broiler chickens. An eight-week feeding trial involving two hundred and eighty eight (288), day-old chicks purchased from a reputable chick dealer in Uyo Metropolis was used for the study. Four experimental diets each of raw and oven-dried CTSM was formulated such that diets 1, 2, 3, and 4 contained 0%, 5%, 10%, and 15% CTSM respectively. The birds were randomly assigned to the eight dietary treatments of 36 birds each. A treatment was replicated thrice, with 12 birds per replicate in a completely randomized design (CRD). The parameters evaluated were body weight gain, feed intake, feed conversion ratio and blood parameters. Data obtained were subjected to analysis of variance (ANOVA), using SPSS version 20. The results showed that the dietary treatments significantly influenced the growth indices. Weight gain was highest at 10% inclusion of raw CTSM and also at 15% inclusion of oven-dried CTSM. Feed intake response was highest at 10% inclusion of raw CTSM and 15% inclusion of oven-dried CTSM while feed conversion ratio (FCR) was greatly improved at these inclusion levels. The inclusion of raw and oven-dried CTSM at 10% and 15% respectively did not adversely affect carcass qualities and organs. Inclusion of raw CTSM up to 15% adversely affected carcass quality and haematological parameters. Also, haematological parameters of broiler chicken were best at 10% and 15% inclusion of raw and oven-dried CTSM respectively. When all parameters were considered, performance of broiler chickens was best at 10% inclusion of raw CTSM and 15% inclusion of oven-dried CTSM. It is therefore recommended that raw CTSM can only be incorporated into the diets of broiler chickens up to 10% without any detrimental effect. But oven-dried CTSM can be incorporated up to 15% without any detrimental effect.

KEYWORDS: Growth Performance, Hematology, Broiler Chickens, *Cassia tora, Carcass*

INTRODUCTION

The average protein intake in Nigeria is 34.6g per day of which only 10.6g (19.4%) is of animal origin, while the remaining (80.6%) is of plant origin (Ajimohun *et al*., 2012). Animal protein intake in Nigeria can be increased by adequate production of broiler chickens.

Poultry production in recent times has been at a very low ebb as a result of high cost of protein and energy feedstuffs. There has been a steady increase in cost of conventional feed ingredients such as maize, soybean, fishmeal and groundnut cake thus, several researchers have emphasized the use of alternative feed ingredients which do not compete with human and industrial uses (Durunna *et al*., 1999; Nsa *et al*., 2007, Fannimo *et al*., 2009). Any significant reduction in the cost of feeds will significantly reduce the overall cost of production, and

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increase the profit margin of the farmers (Adeniyi and Balogun, 2002).

Cassia tora is a dicotyledonous legume. It is also known as Senna, sickle pod, coffee pod as well as tovara (Assam *et al.,* 2017). *Cassia tora* seeds are one of the wild seeds commonly consumed by both rural and urban dwellers, especially low income earners. Some of these wild seeds have higher nutritional values compared with nutritional values found in some cultivated foods (Kris, 2018).

Cassia tora seed meal is one of the several non-conventional protein feed sources available at little or no cost (Assam *et al.*, 2017). It is a satisfactory protein source in the diets of broiler chickens which can partially replace soybean meal to a certain level without any detrimental effect (Weber and Berry, 2010).*Cassia tora* commonly called 'sickle pod' grows in the wild as weed and the seeds contain 29.54% crude protein (Ingweye *et al.*, 2010) However, limitations to the use of most non-conventional feedstuffs in animal production include bulkiness, palatability, digestibility as well as the presence of anti-nutritional factors such as tannin, oxalate, saponin, trypsin inhibitor and phytic acid (Sood *etal*.,1990). These have made both the producers and consumers to refrain from their use. *Cassia tora* seeds contain anti-nutritional factors such as tannin, phytic acid and saponin which adversely affect protein utilization in broiler chickens (Adamu *et al.,*2013).

Anti-nutritional factors present in *Cassia tora* seeds can be reduced or eliminated by employing any of the following processing methods: soaking, cooking, frying, oven-drying, sun-drying and fermentation (Audu and Aremu, 2011). Any of these methods has good advantages such as destruction of undesirable flavours and odours, production of good flavour, increased digestibility, synthesis of desirable constituents as well as improve the nutritional quality and safety of feed materials (Esenwah and Ikenebomaeh, 2008).

Scientists have found the effects of various feeds on the haematology and serum biochemistry of broiler chickens and other animals and concluded that feed ingredients including non-conventional sources affect animal physiology (Ari and Ayanwale, 2012). Haematological constituents reflect the physiological responsiveness of the animal to its internal and external environments which include feeds and feeding (*Esonu et al., 2001*). Therefore, the aim of this study was to determine the effect of partially replacing soybean meal with raw and oven-dried *Cassia tora* seed meal on the performance of broiler chickens.

MATERIALS AND METHODS

Experimental Site

The study was conducted at the Poultry Unit of the University of Uyo Teaching and Research Farm, Town Campus, Annex, Uyo. The area falls within the tropical rainforest zone of Nigeria. The area is located on latitude $05^{0}02^{1}$N and longitude$07^{0}06^{1}$E with an altitude of 38m above sea level. The area has a mean annual rainfall of 2115mm (Meteorological Station, University of Uyo, Uyo). (https://en.wikipedia.org/wiki/Akwa Ibom State).

Source of *Cassia tora* Seeds and Processing Methods

Cassia tora seeds were harvested from farmlands around Ahmadu Bello University (ATBU), Bauchi State, Nigeria and processed according to procedures stated by Ukachukwu and Obioha, (2000). The husks were removed to obtain the seeds. The seeds were winnowed and divided into two batches. One batch was oven-dried at 75^{0}C for 45 minutes and the other batch was raw (fresh from the field). The seeds were prepared and milled into meal for feed formulation. Samples were taken to the Department of Animal Science Post graduate laboratory University of Uyo to determine the effect of oven-drying on the chemical composition and anti-nutritional factors of *Cassia tora* seed meal using the procedure described by AOAC, (2010). The proximate composition of the test ingredient (*Cassia tora* seeds) for raw in percentage (%) were dry matter (92.00), crude protein (29.52), crude fibre (12.20), Ether Extract (11.00), Ash (6.00), Nitrogen Free Extract (4.28) and for oven-dried also in percentage dry matter (92.08), Crude Protein (29.53), Crude Fibre (10.08), Ether Extract (18.28), Ash (8.00), Nitrogen Free Extract (34.11).

FEED FORMULATION

Four experimental diets each of raw and oven-dried *Cassia tora* seed meal making a total of eight (8) diets were formulated. Processed *Cassia tora* seed meal (CTSM) was incorporated at the dietary levels of 0%, 5%, 10% and 15% for raw and oven-dried CTSM, respectively. The experimental diets were formulated to meet the standard requirements of NRC, (1994). Diet 1(T_1) which served as control contained 0% CTSM while T_2, T_3, T_4 had 5%, 10% and 15% for raw and oven-dried, respectively. The calculated crude protein and metabolizable energy of the diet were as presented in the diets' tables. Experimental broiler starter and finisher diets are presented in Tables 1 and 3, respectively.

Table 1: Composition of Experimental Broiler Starter Diets

Ingredients (%)	Dietary levels of *Cassia tora* Seed meal (%)							
	Raw				Oven-dried			
	0.00	5.00	10.00	15.00	0.00	5.00	10.00	15.00
Maize	47.00	47.00	47.00	47.00	47.00	47.00	47.00	47.00
Soybean meal	34.00	29.00	24.00	19.00	34.00	29.00	24.00	19.00
CTSM	0.00	5.00	10.00	15.00	0.00	5.00	10.00	15.00
F*ish meal*	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
PKC	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Vit/trace min. Premix	0.25	0.25	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	0.25	0.25
L-Lysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
DL-Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Calculated (%)								
ME (Kcal/Kg)	2,945	2,926	2907	2,888	2,945	2,926	2907	\ 2,888
Crude protein	22.58	22.06	21.53	21.01	22.58	22.06	21.53	21.01

1kg of premix contains: vitamin A (5,000,000iu) vitamin D_3(1,000,000, iu), vitamin E (16,000MG), vitamin K_3 (800MG), vitamin B_2 (22,000MG), Niacin (22,000mg), Calcium Panthothenate (4,600mg), vitamin B6 (2,000mg), vitamin B12 (10mg), Folic Acid (400mg), Biotin (32mg), Chroline Chloride (200,000mg), Zinc (32,000mg), Idomi (600mg), Cobalt (120mg), Selenium (40mg), Antioxidant (48,00mg).

Table 2: Proximate Composition of Experimental Diets for Broiler Starter Chicks

	Experimental Diets							
	Raw							Oven-dried
Parameters (%)	T_1 (0%)	T_2 (5%)	T_3 (10%)	T_4 (15%)	T_1 (0%)	T_2 (5%)	T_3 (10%)	T_4 (15%)
Dry matter	90.70	90.71	90.91	91.56	90.70	90.71	90.91	91.56
Crude protein	22.02	22.32	22.08	22.32	22.02	22.32	22.08	22.32
Crude Fibre	5.33	5.70	5.10	4.00	5.33	5.70	5.10	4.00
Ether Extract	6.00	6.81	5.10	4.70	6.00	6.81	5.10	4.70
Ash	9.94	13.95	11.27	15.30	9.94	13.95	11.27	15.30
N FE	56.71	51.22	56.45	53.68	56.71	51.22	56.45	53.68

Table 3: Composition of Experimental Broiler Finisher Diets

Ingredients (%)	Dietary levels of *Cassia tora* Seed meal (%)							
	Raw				Oven-dried			
	0.00	5.00	10.00	15.00	0.00	5.00	10.00	15.00
Maize	54.00	54.00	54.00	54.00	54.00	54.00	54.00	54.00
Soybean meal	25.00	20.00	15.00	10.00	25.00	20.00	15.00	10.00
CTSM	0.00	5.00	10.00	15.00	0.00	5.00	10.00	15.00
F*ish meal*	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
PKC	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Bone meal	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Vit/trace min. Premix	0.25	0.25	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	0.25	0.25
L-Lysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
DL-Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Calculated (%)								
ME (Kcal/Kg)	2,969	2,950	2,931	2,912	2,969	2,950	2,931	2,912
Crude protein	*19.61*	*19.09*	*18.56*	*18.04*	*19.61*	*19.09*	*18.56*	*18.04*

1kg of premix contains: vitamin A (5,000,000iu) vitamin D_3(1,000,000, iu), vitamin E (16,000MG), vitamin K_3 (800MG), vitamin B_2 (22,000MG), Niacin (22,000mg), Calcium Panthothenate (4,600mg), vitamin B6 (2,000mg), vitamin B12 (10mg), Folic Acid (400mg), Biotin (32mg),

Table 4: Proximate composition of Experimental Diets for Broiler Finisher Chicken

	Experimental Diets							
	Raw							Oven-dried
Parameters (%)	**T_1 (0%)**	**T_2 (5%)**	**T_3 (10%)**	**T_4 (15%)**	**T_1 (0%)**	**T_2 (5%)**	**T_3 (10%)**	**T_4 (15%)**
Dry matter	**91.20**	**91.86**	**91.35**	**91.27**	**91.20**	**91.86**	**91.35**	**91.27**
Crude protein	**20.40**	**20.00**	**20.18**	**19.01**	**20.40**	**20.00**	**20.18**	**19.01**
Crude Fibre	**4.15**	**4.58**	**4.39**	**4.82**	**4.15**	**4.58**	**4.39**	**4.82**
Ether Extract	**7.63**	**6.58**	**5.42**	**5.16**	**7.63**	**6.58**	**5.42**	**5.16**
Ash	**9.93**	**11.33**	**12.38**	**11.60**	**9.93**	**11.33**	**12.38**	**11.60**
N FE	**57.89**	**57.51**	**57.63**	**59.34**	**57.89**	**57.51**	**57.63**	**59.34**

Table 5: Proximate composition of the test ingredient (Cassia tora seeds)

Parameters (%)	**Raw**	**Oven-dried**
Dry matter	**92.00**	**92.08**
Crude protein	**29.52**	**29.53**
Crude Fibre	**12.20**	**10.08**
Ether Extract	**11.00**	**18.28**
Ash	**6.00**	**8.00**
Nitrogen Free Extract	**41.28**	**34.11**

MANAGEMENT OF EXPERIMENTAL BIRDS AND DESIGN

A total of two hundred and eighty-eight (288), unsexed Amobyn day-old chicks was used for this study. The birds were divided into eight (8) groups of 36 birds each. Each group was further subdivided into three (3) replicates of 12 birds each and randomly assigned to one of the 8 experimental diets in a completely randomized design (CRD). The starter phase commenced from the first day of the experiment and ended on the last day of the fourth week. The finisher phase started from the fifth week and ended on the last day of the eighth week of the experiment. The experimental birds were not re-assigned at end of starter phase for finisher experiment. The same number of birds was used since there was no mortality. The experimental birds were raised on deep litter system during the starter and finisher phases. Wood shavings were used as the litter material. Bulbs were connected to each pen to aid birds eating at night and also supply warmth. Other sources of heat were kerosene stove and lantern. All necessary medications and vaccinations were routinely administered.

DATA COLLECTION

The following data were collected

a. Initial body weight: The weights of the birds were taken in grams (g) at the commencement of the experiments. The average initial body weights were similar across the treatments.

b. Feed intake: Feed intake was measured in grams (g) by subtracting the weight of the left-over feed from the weight of the feed fed the previous day.

(i) Total feed intake: This was determined as the total feed consumed by the birds throughout the feeding trial.

(ii) Daily feed intake: This was determined by dividing the total feed consumed by the number of days of the experiment.

$$\text{Daily feed intake} = \frac{\text{Total feed intake}}{\text{Number of days of the experiment}}$$

a. Total weight gain: This was determined as the difference between the final and initial weights.

b. $$\text{Daily weight gain} = \frac{\text{Total weight gain (g)}}{\text{Number of days (day)}}$$

c. Feed conversion ratio (FCR): This was calculated by dividing daily feed intake by daily weight gain.

$$\text{FCR} = \frac{\text{Daily feed intake (g)}}{\text{Daily weight gain (d)}}$$

Carcass Analysis of Experimental Birds

At the end of the *e*ighth week carcass analysis was carried out to determine the effect of experimental diets on the birds. Two birds were slaughtered from each replicate. The birds were starved over night before slaughtering. The data collected were as shown in the carcass analysis table.

Blood Collection and Evaluation

Blood samples were collected from one bird each selected from each replicate at weeks 4 and 8. The blood samples were collected from the wing vein with sterile needle into well labelled sterilized bottles that contained ethylene diamine tetra-acetic acid (EDTA) as anticoagulant for haematological analysis. The bottles were immediately capped and the contents mixed gently by repeated inversion. The samples were then analyzed at the University of Uyo Teaching Hospital laboratory. White blood cell (WBC), Red blood cell (RBC) or erythrocytes count, platelet, packed cell volume, haemoglobin concentration, erythrocyte indices which includes; the mean corpuscular volume, or "Mean Cell Volume" (MCV), the mean corpuscular haemoglobin, or "Mean Cell Haemoglobin" (MCH), mean corpuscular haemoglobin concentration (MCHC), were determine using Mindray Auto Haematology Analyser, model BC-5300, manufactured by Shenzhen Mindray Biomedical Electronics Ltd, China. The Auto Haematology Analyser machine was switched on and it automatically flushed the fluidic lines, checked the background and entered the count screen. Readings were automatically read and printed out.

Statistical Analysis

Data obtained from the experiments were subjected to analysis of variance (ANOVA) in a completely randomized design (CRD) using SPSS Version 20. Significant means were separated using Duncans multiple Range Test option of the software.

RESULTS AND DISCUSSION

The results obtained for the performance of broiler chickens fed with graded levels of raw and oven dried *Cassia tora seed meal* are presented on Table 6. Broiler chickens fed the control diet for raw (0% CTSM) were similar to birds fed 5% and 10% CTSM in terms of final weight, weight gain and daily weight gain but significantly ($P<0.05$) different from birds fed 15% CTSM. The weight gain obtained in the study were 2019.65, 2002.06, 2001.17 and 1752.56 for 0%, 5%, 10% and 15%, respectively. This agreed with the results of the study carried out by Makama *et al.,* (2020) who reported that birds fed with higher levels of raw senna obtusifolia seed (*Cassia tora* seed) had poor performance in terms of body weight and weight gain.

The results of the birds fed with oven-dried CTSM showed that there were no significant ($P>0.05$) differences in initial weight, final weight, weight gain and daily weight gain. The values for initial weight (g/bird) in the study were 38.67, 38.90, 38.70 and 38.80 for 0%, 5%, 10% and 15%, respectively. *Cassia tora* seed meal (CTSM) inclusion increased final body weight and body weight gain of poultry chickens fed diets 2, 3 and 4. This agreed with the result of the work carried out by Tsado *et al.* (2012), who reported that rabbit fed with graded levels of *Cassia tora* seed meal diets supplemented with tridax forage showed positive growth response.

Also significant ($P<0.05$) differences were observed in their total feed intake, daily feed intake and feed conversion ratio in raw CTSM. Birds fed 15% raw CTSM were significantly ($P<0.05$) higher in total feed intake, daily feed intake and feed conversion ratio than others. The significant dietary effects on feed intake could point to inability of the broiler chickens to tolerate contents of anti-nutritional factors in the raw *Cassia tora seed meal* (Kumar, 2003). Absence of anti-nutritional factors in the control diet (0%) accounted for effective utilization of nutrients in that group and was responsible for highest weight gain and lower feed conversion ratio of birds fed the diets. The high feed intake and decreased weight gain as well as increased feed conversion ratio by birds fed15% CTSM are attributed to increasing contents of anti-nutritional factors in the raw *Cassia tora* seed meal as a result of increasing level of inclusion of the seed meal. This agrees with the result of the study carried out by Ahmad *et al*. (2000). Similar decreased weight gain and elevated feed conversion ratio have been linked to contents of anti-nutritional factors in the diets. The feed conversion ratio of broiler chickens fed 15% raw CTSM (2.76) was significantly ($P<0.05$) higher than others. The 15% *Cassia tora* seed meal inclusion birds recorded the poorest feed conversion ratio probably due to the inability of the birds to utilize required nutrient from the feed because of the effect of anti-nutritional factors which reduced feed digestibility and utilization. (Esenwah and Ikenebomaeh, 2008).

Significant ($P<0.05$) differences were however observed in their total feed intake, daily feed intake and feed conversion ratio in oven-dried CTSM. Birds fed 5% oven-dried CTSM had significantly different values for total feed intake, daily feed and feed conversion ratio compared to those on other dietary treatments. Broiler chickens fed 15% oven-dried CTSM were not different in terms of feed conversion ratio from the control diet. This showed that inclusion of processed CTSM up to 15% has no detrimental effect on the performance of broiler chickens.

Table 6: Growth Performance of Broiler Chicken Fed Diets Containing Graded Levels of Raw and Oven-dried *Cassia tora* Seed Meal.

Parameters (%)	Experimental Diets							
			Raw				Oven-dried	
	T_1 (0%)	T_2 (5%)	T_3 (10%)	T_4 (15%)	T_1 (0%)	T_2 (5%)	T_3 (10%)	T_4 (15%)
I B wt.	36.44	36.58	36.62	36.59	38.67	38.90	38.70	38.8
F.B. wt.	2056.60[a]	2038.65[a]	2037.79[a]	1778.75[b]	2078.74	2088.67	2087.81	2082.70
W. G.	2019.65[a]	2002.06[a]	2001.17[a]	1752.56[b]	2040.07	2049.77	2049.11	2043.90
D.W. G.	36.06[a]	36.09[a]	35.73[a]	31.29[b]	36.43	36.60	36.59	36.50
T. F. I.	4686.45[b]	4654.35[b]	4624.29[b]	4839.52[a]	4763.92[a]	5204.35[a]	4774.00[b]	4768.96[b]
D.F. I.	83.67[b]	83.11[b]	82.91[b]	86.42[a]	85.42[b]	92.95[a]	85.25[b]	85.16[b]
F C R	2.32[b]	2.32[b]	2.31[b]	2.76[a]	2.34[b]	2.54[a]	2.33[b]	2.33[b]

[a,b] means with different superscripts on the same row are significantly ((p< 0.05) different.

I. B. Wt.	=	Initial body weight (g/bird)	W.G.	=	Weight gain (g/bird)
F. B. Wt.	=	Final body weight (g/bird)	D. W. G.	=	Daily weight gain (g/bird)
T. F. I.	=	Total feed intake (g/bird)	D. F. I.	=	Daily feed intake (g/bird)

The results of the carcass characteristics of broiler chickens fed raw and oven-dried *Cassia tora* seed meal are presented on Table 7. The results for raw CTSM indicated that there were significant (P<0.05) differences in live weight, dressed weight and dressing percentage. Broiler chickens fed 0% CTSM (2001.49) differ significantly (P<0.05) from those fed 5% CTSM (1964.31) and 15% CTSM (1976.52) in live weight but similar (P>0.05) to those fed 10% CTSM (2004.24). Dressed weights obtained in the study were 1221.60, 1217.03, 1227.51 and 1219.34 for 0%, 5%,10% and 15% CTSM, respectively. Birds fed15% CTSM were significantly (P<0.05) different in dressed weight from 10% but similar (P>0.05) to 0% and 5%. Birds fed 0% CTSM were similar (P>0.05) to 10% in dressing percentage but significantly (P<0.05) different from 5% and 15%. Dressing percentage was significantly influenced by the dietary treatments and the values obtained from the study which ranged from 61.03% – 61.96% were lower than the range of 63% -71% reported by Odunsi *et al.*, 1999.

The cut parts expressed as percentage of dressed weight indicated that back, thigh, drumstick and the wing did not show any significant difference (P>0.05) as the inclusion level of raw *Cassia tora* seed meal increased in the diets. However, significant (P<0.05) difference was observed in the breast of the birds. Birds fed 0% CTSM (23.00) were significantly (P<0.05) lower than 10% (23.22) and 15% (23.32) in breast but similar (P<0.05) to 5% (22.92).

There were significant (P<0.05) differences across the dietary treatments in liver, heart, kidney, gizzard and abdominal fat. Pancreas did not show any significant (P>0.05) difference across the dietary treatments. The significant differences (P<0.05) observed in liver and kidney could be linked to the roles of these organs in elimination of metabolic wastes and toxins from the body of the birds especially as the level of inclusion of the test ingredient increases. This result agrees with the work of Onyeyilli *et al.,* (1998) who reported that liver and kidney are primary organs of biotransformation in animals.

Also, the results for oven-dried CTSM indicated that there were significant (P<0.05) differences in live weight, carcass weight, dressed weight and dressing percentage across the dietary treatments. The live weight of birds fed 15% CTSM (1892.15) were significantly (P<0.05) lower than those fed 0%, 5% and 10%. Birds fed the control diet (0%) were not significantly (P>0.05) different from those fed 5% (1899.19). The dressing percentage of the control (0%) was significantly (P<0.05) higher than those fed diets containing graded levels of *Cassia tora* seed meal. The dressing percentages of the birds fed oven-dried CTSM (71.02, 70.99 and 71.07) were within the range of 63% - 71% reported by Odunsi *et al.* (1999).

The cut parts expressed as percentage of dressed weight indicated that the breast, back, thigh, and drumstick showed no significant (P>0.05) differences as the inclusion level of oven-dried *Cassia tora* seed meal in the diets increased. The utilization of the *Cassia tora* seed meal did not suppress the physiological development of the broiler chickens. Better utilization of the seed meal could be attributed to minimum level of anti-nutritional factors as a result of the processing method (oven-drying).

On the other hand, significant (P<0.05) different existed in the wing of the birds. The wing of birds fed 0% CTSM (11.60) were significantly (P<0.05) lower than others, whereas those fed 5%, 10% and 15% were statistically similar (P>0.05).

Also, there was no significant (P>0.05) difference in size of gizzard across the dietary treatments. However, significant (P<0.05) difference were observed in heart, liver, kidney and pancreas. The significant differences observed in kidney and liver could be linked to their roles in elimination of metabolic wastes and toxins from the body of the birds. This result agrees with the report by Onyeyilli *et al.* (2008) that kidney and liver are primary organs of biotransformation in animals. The increase in the size of the liver across the dietary

treatment indicates that it worked very hard in eliminating toxins from the body.

The significant (P<0.05) difference observed in abdominal fat indicates that the increase in the test ingredient did not create any additional metabolic stress or toxicity to the birds. Nwambe *et al.* (2011) had observed that no additional stress was observed in broiler chickens when replacing bambara groundnut meal with soya bean meal in their diets.

Table 7: Carcass Characteristics of Broiler Chickens Fed Diets Containing Graded Levels of Raw and Oven-dried *Cassia tora* Seed Meal.

Experimental Diets

Parameters (%)	T_1 (0%)	T_2 (5%)	T_3 (10%)	T_4 (15%)	T_1 (0%)	T_2 (5%)	T_3 (10%)	T_4 (15%)
Live wt. (g)	2001.49[a]	1964.31[c]	2004.24[a]	1976.52[b]	1900.33[a]	1899.18[ab]	1896.39[b]	1892.15[c]
Carcass wt.(g)	1717.37	1715.06	1718.23	1720.16	1720.33	1719.29	1715.84	1715.07
Dressed wt.	1221.60[b]	1217.03[c]	1227.51[a]	1219.34[bc]	1370.33[a]	1348.80[b]	1346.20[bc]	1343.78[c]
Dressing %	61.03[c]	61.96[a]	61.24[c]	61.64[b]	7 2.11[a]	71.02[b]	70.99[b]	71.02[b]
Cut parts (% Dressed weight)								
Back	20.64	20.64	20.29	20.54	23.52	23.17	22.92	23.37
Breast	23.00[c]	22.91[c]	23.22[b]	23.32[a]	25.04	24.34	24.77	24.76
Thigh	13.95	13.97	13.98	13.53	15.32	15.28	15.03	15.20
Drumstick	13.94	13.95	13.798	13.95	14.43	14.47	14.40	14.10
Wing	13.00	13.00	13.00	13.00	11.60[c]	12.10[b]	12.21[ab]	12.33[a]
Organs (% Dressed weight)								
Heart	0.55[b]	0.56[b]	0.61[a]	0.50[c]	0.70[b]	0.69[b]	0.73[a]	0.68[b]
Liver	3.07[b]	3.11[b]	3.53[a]	3.51[a]	3.03[b]	3.13[b]	3.71[a]	3.91[a]
Kidney	0.51[c]	0.57[b]	0.70[a]	0.68[a].	0.70[b]	0.72[b]	0.82[a]	0.70[a]
Gizzard	1.98[a]	1.90[b] 1.90[b]	1.98[c]	2.50	2.55	2.60	2.82	
Pancreas	0.23	0.23	0.23	0.22	0.23[ab]	0.22[b]	0.25[a]	0.23[ab]
Abdominal	1.84[a]	1.79[a]	1.69[b]	1.51[c]	1.81[a]	1.79[a]	1.66[ab]	1.48[b]

a,b,c means on the same row with different superscripts are significantly (p< 0.05) different.

Tables 8 shows the result of the effect of raw and oven-dried *Cassia tora* seed meal on haematological parameters on broiler chickens at 8 weeks. The results revealed that there were no significant (p<o.5) differences for all the blood parameters across treatment groups. This implies that *Cassia tora* seed meal is safe for feeding broiler chickens either raw or oven-dried with inclusion level of 10% and 15% respectively without any effect on the blood parameters. The values of PVC, RBC, Hb, WBC, MCV, MCH and MCHC obtained in this study fall within the normal haemotological range of the parameters for broiler chickens (Augustine *et al.,* 2017). PVC (25-45), RBC (2-4), Hb (7-13).

Table 8*:* Haematological Indices of Broiler Chicken Fed Diets Containing Graded Levels of Raw and Oven-dried *Cassia tora*Seed Meal at 8 Weeks.

Parameters (%)	**Experimental Diets**							
	Raw				**Oven-dried**			
	T_1 (0%)	T_2 (5%)	T_3 (10%)	T_4 (15%)	T_1 (0%)	T_2 (5%)	T_3 (10%)	T_4 (15%)
P C V (%)	29.45	29.56	27.21	27.21	34.00	34.00	35.00	35.00
Hb (g/dl)	5.86	7.05	6.48	6.12	7.00	8.50	8.20	8.00
W B C x10^3µl	21.00	22.00	22.00	21.00	25.20	26.65	24.8	22.64
R B C x10^6µl	3.60	3.20	3.70	4.00	5.33	5.20	5.69	5.54
M C V (fl)	45.00	46.00	45.00	44.98	55.02	56.00	55.00	55.00
M C H (pg)	11.50	12.82	12.52	11.30	12.50	16.50	15.00	12.70
M C H C (g/dl)	20.00	25.00	23.00	20.25	24.67	30.00	28.00	25.00

PCV = Packed cell volume, Hb= Haemoglobin, WBC= White Blood Cell, RCB = Red Blood Cell, MCV = Mean Corpuscular Volume, MCH = Mean Corpuscular Haemoglobin, MCHC = Mean Corpuscular Haemoglobin Concentration.

CONCLUSION

Performance of broiler chickens fed raw CTSM at 10% was similar to the control (0%) and oven-dried CTSM at 15% was similar to the control (0%). The results of the study have proven that *Cassia tora* seed meal does not interfere with the general performance of the broiler chickens at 10% and 15% inclusion levels of raw and oven-dried CTSM, respectively.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations were made:

i. The raw *Cassia tora* seed meal can only be incorporated in broiler diets to replace soyabean meal up to 10% inclusion level without any detrimental effect.

ii. Oven-dried *Cassia tora* seed meal can be incorporated in broiler diets to replace soyabean meal up to 15% inclusion level without any detrimental effect.

iii. Haematological indices indicated that broiler chickens fed raw and oven-dried *Cassia tora* seed meal had normal and healthy cells.

iv. Further studies should be conducted to ascertain the effects of CTSM in broiler diets.

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