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Performance and blood metabolites of broiler chickens fed graded levels of tallow (*Detarium microcarpum*) seed meal

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Abstract

The objective of this study was to assess the effects of graded levels of dietary *Detarium microcarpum* seed meal (DM) on performance, haematological and biochemical parameters in broiler chickens. DM was included at DM 0, DM 5, DM 10, DM 15 and D20% in diets of 225 one day-old unsexed "Sayed" broiler chicks. The results showed that body weight gain and feed intake were depressed (P>0.05) at DM10, DM15 and DM 20% inclusion levels in the diets. The feed conversion ratio was superior (P>0.05) for DM15 (2.08) and DM20% (2.09) diets, respectively. Inclusion of dietary DM did not influence (P>0.05) mortality rate and had no adverse effect on haematological and biochemical variables. Therefore, further study on higher inclusion level is suggested.

Keywords: *Detarium microcarpum*, Performance, Broilers, Haematology, Biochemical Indices

Introduction

In Nigeria, there is inadequate supply of grains, grain by-products, oil-seed cakes and other agro-industrial wastes to sustain small and medium-scale poultry production**.** Therefore, there is need to explore and provide information on many non-conventional feed ingredients that abound in our environment, with a view to ascertaining their suitability in poultry rations. This need has arisen because of the high cost of the conventional feed ingredients such as soybean meal, groundnut meal, maize and fishmeal, as well as, the desire to diversify and expand the feed raw materials resource base for poultry ration formulation (Abeke et al., 2008. *Detarium microcarpum* seeds are in abundance during the fruiting season, yet the utilization as feed ingredient for poultry is limited due to the presence of anti-nutritional factors (ANFs) (saponin, phytic acid, oxalate and hydrogen cyanide) which have been reported to result in poor growth, poor feed conversion efficiency, changes in some organs, haematological, biochemical and even cause mortality when fed raw to broiler chickens (Anhwange et al., 2004; Obun et al., 2008).

Ingestion of numerous dietary components has been found to have measurable effort on some blood constituents (Fashina, 1991). Therefore, blood provides a valuable medium for clinical investigation of nutritional status of individuals. Cooking improves the nutritive value by destroying most of the ANFs (Amaefule and Obioha, 2001) and utilization of protein and energy in the legumes (Abeke et al., 2008). This study is designed to investigate the effects of dietary cooked DMSM on the growth performance, haematological and biochemical indices of finished broilers birds.

Materials and Methods

This study was conducted in the poultry unit of Teaching and Research Farm of Federal College of Wildlife Management, New Bussa, Niger state. The temperature and relative humidity averaged 34°C and 60% during the study period.

Dry *Detarium microcarpum* fruits were collected from New Bussa and Ibbi, Niger State, Nigeria. The fruits were cracked open mechanically to collect the seeds, which were cleaned of dirt before processing. Water was boiled (100°C) under open drum using fuel wood fire before the seeds were poured into boiling water and allowed to cook for 1h and 20 minutes. The cooked seeds were partially dehulled to remove the seed coats, washed and sun-dried and milled with a

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grinding machine and referred to as *Detarium microcarpum* seed meals (DM).

Five diets in each of the starter and finisher phases were formulated at different inclusion levels of DM0, DM5, and DM10, DM15 and DM20%, respectively supplementing GNC component in a maize based diet (Table 1).

A total of 225 day-old unsexed 'Sayed' broiler chicks starter were purchased from Ibadan, Oyo State, Nigeria. The birds were randomly divided into five treatments of 45 birds each, replicated three times (15 birds per replicate) in a complete randomized design (CRD).

Birds were raised under deep litter system of management using 2.5×1m pen sizes. The house with the foot dip at the entrance was disinfected 2 weeks prior to stocking of the chicks. Feed and water were supplied *ad libitum* while vaccination and medications were strictly adhered to as recommended by the broiler breeders' company. The chicks were brooded on papers spread on the floor for the first 7 days and later wood shavings were used till the end of the experiment. Electric heat was supplied using 200 watts bulb for the first four weeks with the room temperature maintained at 28-32°C. The lamps' heights were adjusted weekly to control (reduce) the heat. The birds were also prophylactically treated against bacterial infections at the second week using terramycin (chick formula) soluble powder (50g in 50 litres) and against coccidiosis using embazin forte at 30 g per 50 litres water on the 18th day. On the third and fourth weeks, birds were vaccinated against Newcastle disease using La sota vaccine and Gumboro using Gumboro vaccine. The starter phase lasted for 28 days while the finisher phase lasted for four weeks, i.e., from 5 to 8th weeks of age.

The chickens had *ad libitum* access to feed and water. Initial body weights before commencement of the trial and weekly thereafter were recorded while feed fed and left over every morning before fresh feed is served was also taken. Growth performance was determined according to methods of Aduku (2004).

Blood was collected on the 8th week of the experimental trial. Three birds per treatment were randomly selected and bled via wing veins using sterile gauge needles and syringes. About 5 ml of blood was collected into two sets of five sterilized glass tubes/bottles. For haematology, the blood samples were collected into a set of five sterilized bottles containing Ethylene Diaminetetra-acetic Acid (EDTA). Blood samples for serum biochemical studies were collected into plain vacutainers (i.e., without anticoagulant) for serum separation. Serum was obtained by centrifugation and the separated serum samples were used for analysis. The packed cell volume, red blood cells, haemoglobin, white blood cells and its differentials (lymphocytes, neutrophils and eosinophils) were analyzed according to Schalm et al. (1975) methods. The data generated from blood analyses were used to calculate mean corpuscular volume (MCV), mean corpuscular haemoglobin concentration (MCHC) and mean corpuscular haemoglobin (MCH) as described by Margi Sirois (1995).

The blood serum was used to determine serum total protein (TP) by kjedahl method as described by Kohn and Allen (1995). Albumin was determined using the BCG (bromocresol green) method as described by Peters et al. (1982). Creatinine concentration of the sera was determined using commercial kit (Creatinine Liquicolor, Germany) while glucose, nitrogen urea and cholesterol were analyzed using sigma assay kits as described by Coles (1986). Aspartate aminotransaminase (AST), Alanine aminotransaminase (ALT) and Alkaline phosphatase (ALP) activities were determined using commercial kits and spectrophotometric method as described by Reitman and Frankel (1957); Bergmeyer (1972); Rej and Hoder (1983).

The proximate composition of the experimental diets was performed according to AOAC (2006) procedure.

Statistical Analysis

Data were subjected to analysis of variance (ANOVA) using SPSS version 15.0 of Windows 2003 model. Statistical means were separated using LSD.

Results and Discussion

The chemical composition of the analyzed experimental diets is shown in Table 1. The crude protein, ether extract, ash, crude fibre and its fractions (NDF and ADF) increased slightly with increased DM inclusion levels. This increase may be due to the nutrient contents of the seed meal. However, the CF range values (4.12-5.20 %) in the diets are within the recommended values of 6.5-7% (Ndife and Nidife, 1980). Calcium (0.99-1.07%) and phosphorus (0.38-0.60%) were within the range of nutrient requirement recommended for broilers in the tropics (NRC, 1994).

The results in Table 2 showed the values of body weight gain (BWG) for treatments DMO (1858.33g), DM5 (1852.09g), DM10 (1831.68g), DM15 (1844.67) and DM20 (1841.14g), respectively. There was no significant (P>0.05) differences between the treatments in BWG. However, treatments DM0 and DM5 tended to have the highest numerical BWG values.

The comparative improvement in the performance of broilers fed the control and cooked DM supplementation could be that cooking for 80 minutes improves palatability of the diets by possibly eliminating the anti-nutritional substances in the seeds.

Table 1: Experimental starter diets

Ingredients	Starter diets					Finisher diets				
	DM0	DM5	DM10	DM15	DM20	DM0	DM5	DM10	DM15	DM20
Maize	51.50	47.75	44.00	40.25	36.50	56.00	52.00	48.00	44.00	40.00
Maize bran	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50
Wheat bran	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50
GNC	25.00	23.75	22.50	21.25	20.00	20.00	19.00	18.00	17.00	16.00
DMSM	0.00	5.00	10.00	15.00	20.00	0.00	5.00	10.00	15.00	20.00
Fish meal	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Oyster shell	1.50	1.50	1.50	1.50	1.50	2.00	2.00	2.00	2.00	2.00
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Lysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	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	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	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
**ME(kcal/kg)	2934.0	2950.0	2956.0	2959.0	2965.0	3103.0	3115.0	3133.0	3157.0	3169.0
Analyzed chemical composition of experimental diets										
Dry matter	92.99	93.00	92.75	93.30	92.80	90.04	89.16	89.55	89.30	89.33
Crude protein	22.67	22.69	22.86	22.90	22.97	19.20	19.34	19.47	19.53	19.67
Crude fibre	4.20	4.30	4.61	4.71	4.80	4.12	4.36	4.70	4.86	5.20
Ether Extract	4.31	4.61	5.11	5.26	5.74	3.50	3.69	4.00	4.16	4.22
Ash	3.77	3.90	3.91	4.02	4.12	4.00	4.28	4.50	5.23	6.29
NFE	65.05	64.52	63.51	63.11	62.37	69.18	68.33	67.66	66.22	64.62
NDF	24.00	24.10	24.66	24.80	24.90	23.18	25.55	26.30	26.81	26.93
ADF	13.14	13.19	13.29	13.46	13.69	15.78	16.20	17.40	17.88	18.00
Ca	1.02	1.05	1.07	1.09	1.01	1.00	0.99	1.01	1.06	1.10
P	0.64	0.60	0.60	0.58	0.54	0.42	0.40	0.38	0.40	0.40

*Premix to provide per kg of feed : Vitamin A, 12,500,000 I.U., Vitamin D3 2,500,000 I.U., Vitamin E 40,000 mg; Vitamin K3, 2000 mg; Vitamin B1,3000 mg; Vitamin B2,5,500 mg; Biotin, 80 mg; Vitamin B12,25 mg; Folic acid, 1000 mg; Choline chloride, 500,000 mg; Manganese, 120,000 mg; Iron, 100,000 mg; Zinc 80,000 mg; Copper, 8,500 mg; Iodine, 1,500 mg; Cobalt, 300 mg; Selenium 120 mg; **Calculated ME

Table 2: Performance of finisher broiler chicks' fed experimental diets

Parameters	Diets (%)					SEM
	DM0	DM5	DM10	DM15	DM20	
Initial body weight (g/bird)	40.00	40.00	40.00	40.00	40.00	0.00
Final body weight (g/bird)	1898.33	1892.09	1871.68	1884.67	1881.14	2.54
Body weight gain (g/bird)	1858.33	1852.09	1831.68	1844.67	1841.14	1.84
Total feed intake (g/bird)	4165[a]	4142.87[a]	3987.53[b]	3842.80[c]	3842.69[d]	82.97
Feed conversion ratio	2.24	2.24	2.18	2.08	2.09	0.03

[a-d] Means on the same row with different superscripts are significantly different (P<0.05)

The result of the broilers performance in this finding is similar to earlier reports on cooked soybeans (Tion and Adeka, 2000; Kaankuka et al. 2000; Amaefule and Obioha, 2001). Omoikhoje (2008) and Mathew et al. (2010) reported a similar performance while working with rats fed cooked Bambara groundnut and broilers fed cooked pigeon pea. The trend in this study in respect to similarity (P>0.05) in performance indices showed that the cooking time must have been mediated by the complete elimination of some anti-nutrient substances inherent in the intact seeds.

The feed intake (FI) of the birds fed diets DM0 (4165g) and DM5 (4142.87g) were similar (P>0.05) but significantly (P<0.05) higher than those on diets DM10 (3987.53g), DM15 (3842.80g) and DM20 (3842.69g) (Table 2).The decrease in FI may be due to the increase in the energy levels in the diets with increased DM inclusion resulting from high fat contents in detarium seed meals. The decrease in FI with increased dietary DM inclusion in the diets in this study is in agreement with report by Smith (1990); Plavink et al. (1997); McDonald et al. (2002) and Nahason et al. (2005) who reported that the major dietary factor which affects FI is the concentration of energy in the diet. An increase in dietary energy results in a decrease in FI.

The FCR of the birds was similar (P>0.05) across the diets but was superior in birds fed diets DM15 (2.08) and DM20 (2.09). The superior FCR of birds on processed diets suggests that there was enhanced availability, digestion, absorption and utilization of the nutrients in the processed seeds by broilers. Similar observations have been reported by Obun et al. (2008) when fed broilers 60 minutes cooked *D. microcarpum* seed meal.

Table 3: Haematological constituents of finisher broilers fed experimental diets

	Diets					
Components	DM0	DM5	DM10	DM15	DM20	SEM
PCV (%)	32.46	32.05	31.14	30.71	30.58	0.23
RBC ($\times 10^6/mm^3$)	2.93	2.95	2.92	2.90	2.87	0.02
Hb (g/dl)	8.79	9.14	8.29	8.22	8.16	0.12
WBC ($\times 10^6/mm^3$)	29.55	28.93	29.14	29.30	28.13	0.18
Neutrophil (%)	30.08	30.37	30.91	30.13	31.00	0.15
Basophils (%)	3.91	3.91	3.92	3.94	3.95	0.04
Lymphocytes (%)	58.35	58.27	58.39	59.37	60.56	0.33
Eosinophils (%)	7.30	7.35	7.18	7.21	7.87	0.12
MCV	110.78	108.64	106.64	105.90	106.55	0.12
MCHC	27.08	28.52	26.62	26.77	26.68	0.42
MCH	30.00	30.98	28.39	28.34	28.43	0.46

Table 4: Biochemical indices and enzyme activities of finisher broiler chicks' fed experimental diets

	Diets					
Components	DM0	DM5	DM10	DM15	DM20	SEM
Total protein (g/dl)	5.31	5.27	5.26	5.24	5.18	0.07
Albumin (g/dl)	2.92	2.91	2.93	2.93	2.92	0.08
Globulin (g/dl)	2.39	2.36	2.33	2.31	2.26	10.02
Creatinins (mg/dl)	0.98[b]	0.98 [b]	.98 [b]	1.00 [ab]	1.08[a]	1.36
Urea nitrogen (mg/dl)	3.30	3.31	3.37	3.45	3.51	0.06
Cholesterol (mg/dl)	135.93	135.98	137.52	138.40	138.47	1.15
Glucose (mg/dl)	156.63	157.33	155.34	160.47	158.67	0.82
Aspartate transaminase (AST,IU/l)	164.13	163.72	164.28	162.98	160.53	0.83
Alanine transaminase (ALT, IU/l)	24.13	24.36	24.41	24.57	24.83	0.22
ALT/AST ratio	0.15	0.15	0.15	0.15	0.15	0.00
Alkaline phosphatase (ALP, IU/l)	33.26	33.36	33.61	33.69	33.87	0.62

[ab]means on the same row with different superscripts are significantly ($P<0.05$) different

on processed diets suggests that there was enhanced availability, digestion, absorption and utilization of the nutrients in the processed seeds by broilers. Similar observations have been reported by Obun et al. (2008) when fed broilers 60 minutes cooked *D. microcarpum* seed meal.

There was no significant ($P>0.05$) difference in RBC, PCV, Hb, WBC and its differential counts (neutrophil, basophil, eosinophil and lymphocytes), MCV and MCH among dietary birds on the control and other diets (Table 3). The observed slight decrease in differential blood count values up to 15% diet before an increase is in line with submission of Roberts et al. (2003) who opined that an increase in production of leucocytes differential counts is to fight against the foreign substances in the body. The insignificant rise in numerical values in the differential counts may be attributed to the residual ANFs in the processed seed meal. The high values of RBC in birds on diets DM0, DM5, DM10 and DM15 suggest highest oxygen carrying capacity, which could also improve the respiratory levels of the broilers while a decrease in the RBC is usually associated with low quality feed and protein deficiency in the diet (Brown and Chime, 1972). The PCV values of 30-33% and Hb (8.16-9.14 g/dl) fall within the normal range stipulated by Mitruka and Rawsley (1977) and Swenson and Reece (1993) for chickens. The results obtained in this trial suggest that detarium seeds when boiled for 80 minutes can be incorporated in broiler finisher's diet up to 20% without any adverse effect on the immune status.

The similarity in the values of the haematological components could be related to the nutritional adequacy and safety of the test ingredient. This is an indication that ANFs identified before and after cooking were tolerated by the broiler chicks up to 20% inclusion level in this study. MCV, MCHC and MCH are used to indicate various forms of anaemia. The range values of 105.90-110.78 for MCV, 26.62-28.52 for MCHC and 28.39-30.98 for MCH in this study are within the stipulated range values of 100-128 for MCV, 25.4-33.4 for MCH and 25.3-32.5 for MCHC by Mitruka and Rawsley (1977) for normal chickens.

The biochemical indices of finisher broilers are presented in Table 4. There were no significant differences ($P>0.05$) among dietary treatment birds for all the biochemical indices measured in this study. However, similarities existed in values for total protein and serum urea concentrations with increasing DM inclusion levels in the diets.

The results of the serum protein and urea nitrogen is in agreement with the findings of Eggum (1970), Iyayi and Taiwo (2003) and Esonu et al. (2001) who reported that serum urea and total protein contents depend on both the quantity and quality of the protein supplied in the diet. Similarly, the albumin and globulin

fractions in this study were similar across the birds. Harper (1975) reported that increased serum globulin is a signal of infection since this fraction is the principal site for circulating antibodies (immunoglobulin).

The serum glucose concentration was similar (P>0.05) among the dietary treatments (Table 4). The concentration in this study was within the literature limit by Mitruka and Rawsley (1977). Glucose is one of the metabolites measured as an indicator of the energy status of the animal. Normal glucose levels in birds indicate adequate synthesis in the liver from propionate, a major glucose precursor (Houtert, 1993).

Table 4 shows the activities of the serum enzymes Alanine transaminase (ALT), Aspartate transaminase (AST) and Alkaline Phosphatase (ALP). The results indicated no significant difference (P>0.05) among the treatments. Although the values were slightly different for all the experimental diets, they were all within the normal range values for serum transaminase in chicken (Mitruka and Rawsley, 1977). A significant discrepancy in their quality would have reflected in their biochemical indices. Reichman and Connor (1977) concluded that alkaline phosphatase activity is a suitable indicator of calcium status of blood in animals.

Absence of significant (P>0.05) differences in alkaline phosphatase enzyme activity was an indication of good protein quality. Stroev and Makarova (1984) reported that a high ALT/AST ratio indicates pathology involving the liver. ALT/AST values greater than 1.00 indicate alterations involving the liver cells (Tietz, 1982).

Conclusion

In conclusion, the results of the growth performance, feed intake, haematological and biochemical indices suggested that the experimental *D. microcarpum* seed meal diets up to 20% inclusion levels did not impose any detrimental effect on the health status of chicks. Further study on higher inclusion levels is necessary to determine the optimum inclusion of DM in broiler diets.

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