

Effects of raw and toasted *Daniellia oliveri* (Rolfe) seed meal on broiler chicken performance

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**Abstract:**

Two hundred and ten day-old Arbor acre broiler chicks were used to assess the protein quality of raw and toasted *Daniellia oliveri* seed meal (DOSM) on performance, haematology, and some biochemical indices. Seven treatment diets that contained 0% (control), 2.5, 5.0 and 7.5% raw DOSM and 2.5, 5.0 and 7.5% toasted DOSM respectively were randomly assigned to seven groups of 30 birds each, replicated thrice with 10 birds per replicate in a completely randomized design. Chemical analysis indicated that raw DOSM contained (% DM) 26.50 crude protein, 6.02 crude fibre, 4.30 ether extract, 4.06 ash and 47.47 carbohydrate. The results of the crude fibre (3.19%), ash (2.8%) and nitrogen free extracts (40.51%) were reduced after toasting while the crude protein (28.60%) and ether extract (7.85%) increased. The raw DOSM contained (mg/100g) tannin (2.23), phytic acid (30.39), oxalate (20.02), hydrocyanide (6.05) and saponin (2.08). Toasting treatment eliminate almost completely the anti nutritional compounds in the seeds. Performance data indicate that body weight gain and feed to gain ratio were significantly ($P < 0.05$) better in broiler chicks fed 0.0, 2.5 % raw and all levels of toasted DOSM diets than those on 5.0 and 7.5% raw DOSM based diets. The results of the packed cell volume, red blood cell count, white blood cell count, haemoglobin, serum protein, albumin, glucose and cholesterol of birds on 0.0 %, 2.5% raw and all levels of toasted DOSM diets did not showed any significant effect ($P > 0.05$) but differed ($P < 0.05$) from those on 5.0 and 7.5% raw DOSM. The inclusion of 5 and 7.5 % raw DOSM significantly ($P < 0.05$) decreased weight gain, feed conversion ratio, nutrient digestibility, haematological and biochemical indices. From the results, it can be concluded that inclusion of 2.50% raw DOSM and up to 7.5% toasted DOSM as a replacement for ground nut meal has no adverse effects on the performance, haematological and serum biochemistry.

Key words: *Daniellia oliveri* seed, anti nutrients, broiler chicks, performance, blood components.

Introduction

The feed industry is faced with enormous challenges, not only regarding the availability of feed ingredients but also the ability to produce high quality products in a cost-effective manner (Chauynarong *et al.*, 2009). Developing and underdeveloped countries including Nigeria are facing serious increase in competition between mankind and animals for the available conventional foodstuffs especially the monogastric animals ((Muriu *et al.*, 2002;

Tegua and Beynen, 2005). This problem has exacerbated the high cost of feeding, and consequently, of the animal products (Opara, 1996). The increased competition for and scarcity of food have drawn the attention of nutritionists, scientists and agriculturists to the need for research into the use of unconventional feedstuffs that are not a staple food for man, that could meet the nutritional needs of the livestock and possibly be substituted for expensive protein (groundnut cake and soybean meal)

and energy (maize) sources in the coming years ahead (Onyimonony and Onukwufor, 2003). Legumes are rich sources of nutrients especially amino acids and minerals (Ragai *et al.*, 2010). Incorporation of some processed wild legume seed meals such as *Detarium microcarpum*, *Parkia biglobosa* and *Afzelia africana* into broiler chickens have been investigated to result in positive performance (Obun and Ayanwale, 2006; 2007; Obun, 2007; Ayanwale *et al.*, 2007).

Daniellia oliveri is commonly known as *Copaiba balsam*, 'Maje' in Hausa, 'iya' in Yoruba, 'Ozabwa' in Igbo and belong to the family of *caesalpinoideae*. *D. oliveri* is an evergreen plant that grows abundantly in bush fallows, secondary bushes and marginal lands in most of the savannah zones of Nigeria. Different parts of the plant are used for different purposes including mulching and fodder (leaves and twigs), firewood and ethno-medicine (stem and root) (Adekunle, 2004; Hassan *et al.*, 2008; **El-Mahmood** *et al.*, 2008). The seeds have very low human food preference or any industrial use as of now and could therefore form an alternative feed ingredient for livestock production. Most previous studies (Hassan *et al.*, 2008 and **El-Mahmood** *et al.*, 2008) centered on the nutrients and anti nutrients in the seeds. Nutritionally, *D. oliveri* on dry matter basis have been reported to contained 57.84% carbohydrate, 0.60% crude fibre, 27.74 % crude protein, 9.67% lipid and 4.17% ash (Hassan *et al.*, 2008). However, the often high biological value of the seeds is impeded by the presence of substances such as phytate, oxalate, hydrocyanide, tannin and nitrate ((Hassan *et al.*, 2008 and **El-Mahmood** *et al.*, 2008). Different traditional processing methods such as roasting, toasting, cooking and fermenting are pronounced of reducing anti nutritional

factors and raising nutrients bioavailability (Ragai *et al.*, 2010).

Based on lack of literature on the scientific information and data on the utilization of *D. oliveri* seed meal (DOSM) by poultry, this study was therefore embarked upon to investigate the effects of feeding graded level of raw and toasted *D. oliveri* seed meal on broiler chicks' performance.

Materials and Methods

Study site:

This study was conducted in the Poultry Unit of Teaching and Research Farm of Federal College of Wildlife Management (FCWM), New Bussa, Niger State. The poultry building is of open sided type that permits cross-ventilation in the house, with a concrete floor and zinc-roofing sheet. New Bussa is located between latitude 7°31' - 10°00'N and longitude 4°30' - 4°33'E (Adewetan *et al.*, 1980) in the savanna areas of the Kainji Lake Basin. The climate of the area is tropical with average monthly temperature of 34°C and mean annual relative humidity of 60%.

Source and processing of seed

Daniellia oliveri seeds were sourced from the College Reserved Estate when dropped naturally after maturity between the months of April-June. The seeds were cleaned of dirt and shared into two portions. One portion was ground raw to form raw *Daniellia oliveri* seed meal (RDOSM). The second portion was toasted using fire wood with iron pot mixed with sand and seeds in a ratio 1:2. The seeds were turned while still on fire until the seeds cracked open and the white endosperm turned crispy brown at about 30-35 minute of toasting. The toasted seeds were clean of dirt, decorticated and ground in a hammer mill to particle size of 0.02mm sieve and this formed toasted *Daniellia oliveri* seed meal (TDOSM).

Experimental Diets

The raw and toasted *Daniellia oliveri* seed

meals (DOSM) were used to replace groundnut meal (GNC) at 0, 2.5, 5.0, and 7.5 % levels respectively in broiler chick's diets on protein equivalent basis and presented as diets 1 (0% as control), 2, 3, 4, 5, 6 and 7 (Tables 1 and 2).

Experimental Birds and Management:

A total of two hundred and ten (210) day old Abor-Acre broiler chicks were used in this study. The birds were managed in a deep litter pens' house with dimensions of 2.5m x 2.0m each for the eight weeks study period. Feed and water were provided *ad libitum* while necessary prophylaxis and vaccination were administered.

Experimental Design:

The broiler chicks were randomly allotted into seven treatment groups of 210 birds in completely randomized design. Each treatment group consists of 30 broiler chicks, replicated three times (10 birds each).

Measurements:

Body weight performance, feed intake and mortality were recorded on replicate basis weekly while feed conversion ratio was obtained as a ratio of feed: gain.

Nutrient retention trial

The apparent nutrient digestibility study was carried out at the end of the 8th week of the experiment. Three birds per replicate were randomly selected and transferred to metabolic cages for four days adaptation period and four days total collection of the droppings. The droppings were oven dried, bulked and representative samples taken for chemical analysis. The percentage of the nutrients (DM, crude protein, crude fibre, ash and ether extracts) were estimation according to McDonald *et al.* (2002) method as shown below:

Digestibility coefficient

$$= \frac{\text{Nutrient intake} - \text{Nutrient in faeces}}{\text{Nutrient intake}} \times 100$$

1

Haematological and biochemical indices

About 5mls of blood was collected from the jugular veins of each slaughtered chickens into two sets of seven sterilized glass tubes/bottles. For haematology, the blood samples were collected into a set of seven 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 harvested serum samples were used for analysis. The packed cell volume, red blood cells, haemoglobin, and white blood cells were analyzed according to Schalm *et al.* (1975) methods.

The blood serum was used to determine serum total protein (STP) 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). Glucose and cholesterol were analyzed using sigma assay kits as described by Coles (1986).

Chemical Analysis:

Samples of *Daniella oliveri* seeds, experimental diets and faecal droppings were analyzed on dry matter basis for proximate composition according to A.O.A.C (1990) procedures. The raw and toasted seeds were determined for tannin using modified Vanillin assay (Price *et al.*, 1978), oxalate by Day and Underwood (1986) procedure, Phytate by Reddy and Love (1999) method, saponin by Hudson and El-Difrawi (1979) and Hydrogen cyanide by AOAC (1990) method.

Statistical Analysis:

Data obtained were subjected to analysis of variance and treatment means were compared by Duncan's multiple range test (Duncan, 1955) using SPSS 10.0 package.

Table 1: Composition of experimental starter diets

Ingredients	Control	Raw seed meals			Toasted seed meals		
	1 (0.0)	2 (2.5)	3 (5.0)	4 (7.5)	5 (2.5)	6 (5.0)	7 (7.5)
Maize	53.0	52.0	52.0	52.0	52.0	52.0	52.0
Wheat offal	10.0	10.0	10.0	10.0	10.0	10.0	10.0
GNC	30.0	27.5	25.0	22.5	27.5	25.0	22.5
<i>Daniellia</i> seed meals	0.0	2.5	5.0	7.5	2.5	5.0	7.5
Fish meal	3.0	4.0	4.0	4.0	4.0	4.0	4.0
Bone meal	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lysine	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
Salt	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
Total	100	100	100	100	100	100	100
Analyzed composition (% DM)							
Dry Matter	87.32	86.20	86.00	88.00	86.40	89.00	89.00
Crude Protein	22.03	22.17	22.00	22.08	22.33	22.05	21.88
Crude Fibre	3.50	3.54	3.56	3.60	3.57	3.48	3.64
Ash	3.20	3.44	3.28	3.48	3.45	3.30	3.46
Ether Extract	4.65	4.60	4.54	3.77	4.50	4.32	4.07

*Premix provided per kg diet: Vitamin A 15,000 I. U., Vitamin D₃ 3,000 I. U., Vitamin E 15 I.U., B₁₂ 0.013 mg, Vitamin K 4 mg, Riboflavin 10 mg, Folic acid 2 mg, Nicotinic acid 44 mg, Pantothenic acid 13 mg, Biotin 0.064 mg, Vitamin B₁ 2.2 mg, Vitamin B₆ 5.5 mg, Choline Chloride 350 mg, Copper 6.25 mg, Iodine 1.5 mg, Zinc 62.5 mg, Manganese 62.5 mg, Selenium 0.1 mg, BHT (Antioxidant) 100 mg, Zinc Bacitracin 10 mg.

Results

The results of the chemical analysis indicated that raw DOSM contained (% DM) 26.50 crude protein, 6.02 crude fibre, 4.30 ether extract, 4.06 ash and 47.47 carbohydrate. The crude fibre (3.19%), ash (2.8%) and nitrogen free extracts (40.51) were reduced after toasting while the crude protein (28.60%) and ether extract (7.85%) increased. The raw DOSM contained (mg/100g) tannin (2.23), phytic acid (30.39), oxalate (20.02), hydrocyanide (6.05) and saponin (2.08) while toasting treatment eliminate almost completely the anti nutritional compounds in the seeds (Table 3).

Feed intake did not differ ($P>0.05$) among the treatment groups (Table 4). However, birds on 5 and 7.5% dietary inclusion of raw *Daniellia oliveri* seed meals (RDOSM) had lower feed intake from those on 0%, 2.5%

RDOSM and all levels of toasted (2.5, 5 and 7.5%) *Daniellia oliveri* seed meals (TDOSM). The growth rates and feed conversion ratio of the birds on 0, 2.5 RDOSM and TDOSM diets were similar ($P>0.05$) and better than those on 5 and 7.5% RDOSM diets. Mortality increased with increasing concentration of raw DOSM in the diets.

The nutrient retention of dry matter, crude protein, crude fibre, fats and ash contents of birds on 5.0 and 7.5 % RDOSM decreased with increasing inclusion levels while other diets compared favourably ($P>0.05$) with the control diet (Table 5).

The haematological and biochemical indices of broiler chicks fed raw and toasted DOSM diets are presented in Table 6. The result obtained shows that at 2.5% dietary inclusion of raw DOSM, the PCV (30.21%), RBC ($2.76 \times 10^6 \text{ mm}^3$), Hb (10.21g/dl) and WBC ($20.00 \times 10^6 \text{ mm}^3$)

values compared statistically ($P>0.05$) with those of the control group and toasted DOSM groups but differed significantly ($P<0.05$) from those on 5 % and 7.5% raw DOSM dietary groups.

The results of the serum biochemical indices of total protein, albumin, cholesterol and glucose of birds on the control, 2.5% RDOSM and TDOSM diets were similar ($P>0.05$) but significantly ($P<0.05$) superior compared with those on 5 and 7.5% RDOSM which were depressed (Table 6).

Discussion

The proximate composition of raw *Daniellia oliveri* seeds for dry matter (88%), crude protein (26.15%) and ash (4.06%) are similar to values reported by Hassan *et al.* (2008) but disagree with their lower value of 0.6% crude fibre and high values of 9.67% for fats. However, the

nitrogen free extracts values of 47.47 and 40.51% for raw and toasted seeds are lower compared with the literature value of 57.84 % reported by Hassan *et al.* (2008). The variations in values of some chemical compositions may be attributed to differences in processing methods, geographical location and the conditions under which the daniellia trees grow.

The high feed intake with increase in dietary level of TDOSM up to 7.5% inclusion could be due to better detoxification of the anti nutrients by thermal (toasting) processing of the seeds. However, the significant decline in feed intake at 5 and 7.5 % dietary inclusion of RDOSM could perhaps be attributed to the presence of some anti-nutritional factors (ANF), which are thought to be prevalent in most raw legume feedstuffs (D'Mello 1982). The low feed intake could probably caused by an astringent taste induced by

Table 2: Composition of experimental finisher diets

Ingredients	Control	Raw seed meals			Toasted seed meals		
	1 (0.0)	2 (2.5)	3 (5.0)	4 (7.5)	5 (2.5)	6 (5.0)	7 (7.5)
Maize	55.0	55.0	55.0	55.0	55.0	55.0	55.0
Wheat offal	10.0	10.0	10.0	10.0	10.0	10.0	10.0
GNC	28.0	25.5	23.0	20.5	25.5	23.0	20.5
Daniellia seed meals	0.0	2.5	5.0	7.5	2.5	5.0	7.5
Fish meal	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Bone meal	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lysine	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
Salt	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
Total	100	100	100	100	100	100	100
Analyzed composition (% DM)							
Dry Matter	89.60	90.34	90.20	89.70	89.50	90.04	89.63
Crude Protein	19.50	19.30	19.52	19.34	19.28	19.11	19.00
Crude Fibre	4.40	4.60	4.62	4.67	3.98	4.23	4.36
Ash	3.44	3.65	4.00	3.90	3.75	3.88	3.85
Ether Extract	4.76	3.91	3.57	3.80	4.00	4.14	3.98

* Contains per kg: Vit. A 10000 IU, Vit. B 2000 IU, Vit. E 13000 IU, Vit. K 1500mg, Vit. B₁₂ 10mg, Riboflavin 5000mg, Pyridoxine 1300mg, Thiamine 1300mg, Panthothenic acid 8000mg, Nicotinic acid 28000mg, Folic acid 500mg, Biotin 40mg, Copper 7000mg, Manganese 48000mg, Iron 58000mg, Zinc 58000mg, Selenium 120mg, Iodine 60mg, Cobalt 300mg, Choline 27500mg

Table 3: Proximate composition and anti nutrients of raw and toasted *daniellia* seed meals

Fraction (%)	Raw	Toasted
Dry Matter	88.00	82.95
Crude Protein	26.15	28.60
Crude Fibre	6.02	3.19
Ether Extract	4.30	7.85
Ash	4.06	2.80
Nitrogen Free Extracts	47.47	40.51
Ca	1.44	1.21
P	0.37	0.22
Metabolites (mg/100g)		
Phytic acid	30.39	0.01
Oxalate	20.02	-
Saponin	2.08	-
Hydrocyanide	1.05	-
Tannin	2.23	-

tannins in raw DOSM as reported by Van Soest (1994). The decrease in body weight and weight gain with increase (5.0 and 7.5%) in level of RDOSM diets could be attributed to the low feed consumption and poor feed utilization by the birds. Apart from tannins, other phytochemical compounds such as saponins, oxalate and phytates could have played a role in depressing growth of birds (Zdunczy *et al.*, 1997).

The high mortality observed in birds fed 5.0 and 7.5 % RDOSM is in line with reports by Osagie (1998) that prolonged effects of consumption of ANF sometimes are capable of precipitating deleterious

effects in man and animals, with manifestable toxicity ranging from severe reduction in feed intake and nutrient utilization to profound neurological effects culminating in death.

The enhanced nutrient digestibility of broilers fed TDOSM over 2.5% RDOSM diets is an indication that toasting the seeds with this method improved the quality of the meals to a more biological valued protein that is non toxic, digestible and absorbable. The reduction in nutrients utilization in birds on 5.0 and 7.5% RDOSM may be ascribed to the presence of anti nutritional substances in the diets. This finding is in agreement with earlier report

Table 4: Performance of broiler chicks fed raw and toasted *daniellia* seed meals

Parameters	Diets							SEM
	1	2	3	4	5	6	7	
Initial body wt. (g/bird)	40.03	40.00	40.01	40.00	40.00	40.02	40.00	0.00
Final body wt. (g/bird)	2102 ^a	2066 ^a	1573 ^c	1308 ^d	2087 ^a	2068 ^a	2065 ^b	121.10
Body wt. gain (g/bird)	2062 ^a	2026 ^a	1533 ^d	1268 ^c	2047 ^a	2028.0 ^a	2025 ^b	121.10
Daily wt gain (g/bird)	36.8 ^a	36.2 ^a	27.4 ^b	22.6 ^b	36.6 ^a	36.2 ^a	36.2 ^a	2.17.
Mean FI (g/day/bird)	80.54	80.14	76.30	71.43	80.25	79.46	79.82	1.26
FCR	2.19 ^a	2.20 ^a	2.78 ^b	3.16 ^c	2.19 ^a	2.20 ^a	2.20 ^a	0.15
Mortality (%)	3.33	-	16.67	26.67	-	-	6.67	-

abcd Means on the same row with different superscript are significantly different (P<0.05)

Table 5: Nutrient retentions of broiler chicks fed raw and toasted *Daniellia* seed meals (% DM basis).

Parameters	Diets							SEM
	1	2	3	4	5	6	7	
Dry matter	89.2 ^a	84.6 ^a	75.0 ^b	72.6 ^b	86.1 ^a	86.1 ^a	85.3 ^a	2.38
Crude protein	81.4 ^a	78.0 ^a	67.1 ^b	61.0 ^b	80.0 ^a	79.6 ^a	79.0 ^a	3.00
Crude fibre	78.0 ^a	70.6 ^a	64.2 ^b	62.0 ^b	77.3 ^a	77.0 ^a	74.0 ^a	2.47
Fats	77.0 ^a	71.1 ^a	63.8 ^b	60.0 ^b	76.9 ^a	77.0 ^a	73.0 ^a	2.59
Ash	69.0 ^a	68.4 ^a	57.5 ^b	52.1 ^b	70.0 ^a	71.2 ^a	69.7 ^a	2.82

ab Means on the same row with different superscript are significantly different ($P < 0.05$)

Table 6: Haematological and some serum biochemical indices of broiler chicks fed raw and toasted *daniellia* seed meals

Parameters	Diets							SEM
	1	2	3	4	5	6	7	
PCV (%)	31.3 ^a	30.2 ^a	26.7 ^{ab}	25.1 ^b	31.7 ^a	31.0 ^a	29.0 ^a	0.96
Hb (g/dl)	11.0 ^a	10.2 ^a	7.5 ^b	6.3 ^b	10.9 ^a	10.5 ^a	10.3 ^a	0.70
WBC ($\times 10^6 \text{mm}^3$)	19.3 ^b	20.0 ^b	25.1 ^a	28.5 ^a	19.0 ^b	19.2 ^b	19.0	1.43
RBC ($\times 10^6 \text{mm}^3$)	2.87	2.76	2.40	2.31	2.88	2.78	2.89	0.91
Total protein (g/dl)	5.0 ^a	5.0 ^a	3.6 ^b	3.3 ^b	4.9 ^a	4.9 ^a	4.9 ^a	0.29
Albumin (g/dl)	2.86 ^a	2.8 ^a	2.2 ^b	2.1 ^b	2.7 ^a	2.7 ^a	2.66 ^a	0.11
Cholesterol (mg/dl)	130.0 ^a	127.2 ^a	94.1 ^b	82.4 ^b	129.5 ^a	128.8	126.4 ^a	7.52
Glucose (mg/dl)	176.3 ^a	171.0 ^a	150.0 ^b	142.2 ^b	170.0 ^a	172.0 ^a	168.5 ^a	4.86

ab Means on the same row with different superscript are significantly different ($P < 0.05$)

by Ihekoronye and Ngoddy (1985) that some of these active principles interfere with digestive processes thereby preventing efficient utilization of the legume protein.

The observed decrease in PCV, haemoglobin and RBC values for the birds placed on 5 and 7.5% RDOSM diets compared with those on the control, 2.5 raw and toasted DOSM based diets might indicate an immunological response to the presence of ANF present in the feeds and poor protein utilization (Apata, 1990). The higher values of WBC for birds on 5.0 and 7.5 % RDOSM when compared with other diets might be attributed to the immune system of the birds attempting to detoxify the ANF in the feed. Anti nutritional factors has been reported to have negative effects on some haematological parameters. Saponin is known to cause erythrocyte haemolysis and reduction of blood

(Cheeke, 1996). The low score of broilers fed 5 and 7.5% RDOSM in this study therefore conforms to report of Tacon (1992) that nutritionally deficient diets cause decrease in haemoglobin concentration, heamatocrit and red blood cell. Hackbath *et al.* (1983) reported that increased RBC values are associated with high quality dietary protein and with disease free animals as observed in the control, 2.5 % raw and toasted diets. The low values of total protein, albumin, cholesterol and glucose recorded by birds on 5.0 and 7.5% RDOSM diets in this study attest to the nutritional inadequacy of RDOSM in meeting the protein needs of the broiler. These low values are in agreement with earlier findings by Onifade and Tewe (1993) that the quality of dietary protein influenced their values. Similarly, the low cholesterol and glucose concentration indicates the possibilities of birds having

anorexia, liver dysfunction and mal-absorption of fat, which are the symptoms of abnormal glucose and cholesterol levels in the blood (Bush, 1991).

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