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Evaluation of Substituting Toasted *Daniellia oliveri* Seed Meal for Soybean Meal on the Performance and Economics of Production of Broiler Chickens

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

This study is aimed to evaluate the growth performance, nutrient retention, dressed and organ weights and economics of production using toasted *Daniellia oliveri* seed meal (TDSM) as a source of protein substitute with soybean meal (SBM) in broiler diets for 56 days. One hundred and fifty (150), one-day-old unsex Arbor Acre broiler chicks were randomly distributed into five treatments with 30 chicks each, replicated three times (10 chicks each) in a completely randomized design. *Daniellia oliveri* seed meal protein replaced soybean meal (SBM) at 0, 5, 10, 15 and 20%. Replacing SBM with TDSM protein up to 20% did not affect (P>0.05) growth, feed intake and feed conversion ratio (FCR). The substitution shows reduction in cost of feed intake per bird and percentage saving cost per bird of 13.55, 18.26, 31.77 and 33.2 at dietary 5, 10, 15 and 20% TDSM levels of inclusion. The nutrient digestibility dressed weight, gizzard, abdominal fat, liver, heart and pancreas were not affected ($P > 0.05$) by incorporating TDSM up to 20% in broiler diets. The results suggest that 20% inclusion level of toasted *Daniellia oliveri* seed meal could be effectively used without adverse effects on growth performance, nutrient digestibility, dressed and organ weights and with high production saving cost.

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1. INTRODUCTION

In Nigeria, like other developing countries of the world, protein of animal origin is quite expensive and often not within the reach of the ordinary man due to high cost of production emanating from high cost of conventional feedstuff like groundnut cake and soybeans. The sharp rise in the prices of these conventional plant proteins for poultry diets has created the needs for more research on seeking alternative protein sources of lesser known legumes and bi-products to reduce production cost and maximize profit. Incorporation of some processed wild legume seed meals such as *Detarium microcarpum, Parkia biglobosa* and *Afzelia africana* into broiler chickens have been investigated to results in positive performance [1,2,3].

Daniella 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. 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. Nutritionally, *D. oliveri* on dry matter basis have been reported to contained 47-58% carbohydrate, 1-6% crude fibre, 26-28% crude protein, 4-10% lipid and 2-4% ash [4,5]. However, the often high biological value of the raw seeds is impeded by the presence of substances such as phytic acid, oxalate, hydrocyanic acid, tannin and nitrate [4,5,6]. Different traditional processing methods such as roasting, toasting, cooking and fermenting are pronounced of reducing anti nutritional factors and enhancing nutrients bioavailability [7].

Based on improved performance of broiler chickens fed 7.5% toasted *D. oliveri* seed meals as replacement for ground cake meal reported by [5]. Hence, this study was therefore designed to investigate higher graded inclusion levels of toasted *D. oliveri* seed meal on growth response, nutrient retention and economics of production.

2. MATERIALS AND METHODS

2.1 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. New Bussa is located between latitude $7°31^{1}$- $10°00^{1}$N and longitude $4°30^{1}$-$4°33^{1}$E [8].

2.2 Source and Processing of Seed

Daniella oliveri seeds were sourced from Federal College of Wildlife Reserved Estate between the months of April-May. The raw seeds were 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. The toasted seeds were clean of dirt, decorticated and ground in a hammer mill using 0.2 mm sieve particle size and this formed toasted *Daniella oliveri* seed meal (TDSM).

2.3 Experimental Diets

The toasted *Daniella oliveri* seed meals (TDSM) were used to replaced soybean meal (SBM) at 0, 5, 10, 15 and 20% levels respectively in broilers chick diets (Table 1).

2.4 Experimental Birds and Management

A total of one hundred and fifty (150) day-old Arbor Acre broiler chicks were used in this study. The birds were managed in a deep litter pens' house with dimensions of 2.5 m x 2.0 m each for the eight weeks study period. Feed and water were provided *ad libitum* while necessary prophylaxis and vaccination were administered.

2.5 Experimental Design

The broiler chicks were randomly allotted to five treatment groups of 150 birds in a completely randomized design. Each treatment group consists of 30 broiler chicks, replicated three times (10 birds each).

2.6 Measurements

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

2.6.1 Nutrient retention trial

The apparent nutrient retention study was carried out at the end of the 8^{th} week of the experiment.

Table 1. Composition of experimental diets

Ingredients	Starter diets					Finisher diets (%)				
	0.0	**5.0**	**10.0**	**15.0**	**20.0**	**0.0**	**5.0**	**10.0**	**15.0**	**20.0**
Maize	50.0	50.0	50.0	50.0	50.0	45.0	45.0	45.0	45.0	45.0
Maize offal	10.0	10.0	10.0	10.0	10.0	18.0	18.0	18.0	18.0	18.0
Soybean meal	30.0	25.0	20.0	15.0	10.0	29.0	24.0	19.0	14.0	9.0
TDSM	0.0	5.0	10.0	15.0	20.0	0.00	5.0	10.0	15.0	20.0
Fish meal	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Bone meal	4.0	4.0	4.0	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	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
Salt	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
Calculated analysis (% DM)										
Crude protein	22.08	22.00	21.56	21.30	21.03	19.75	19.70	19. 30	19.18	19.00
ME (kcal/kg)	2872.6	2873	2878.2	2883.0	2892.6	2898.0	2929.0	2933.0	2957.1	2960.8
Analyzed composition (% DM)										
DM	89.37	90.21	89.7	87.4	88.8	94.37	93.54	92.63	92.82	92.85
CP	23.00	22.44	22.02	21.11	21.05	20.11	19.40	19.25	18.70	18.62
CF	3.50	3.97	4.60	4.87	5.20	4.34	4.37	5.26	5.43	5.50
Ash	3.20	3.51	3.76	4.40	4.83	3.04	4.71	5.12	5.22	5.52
EE	4.65	4.70	4.88	4.90	4.97	4.08	4.21	4.76	5.65	5.80

**Premix provided per kg diet: Vitamin A 15,000 I. U., Vitamin D_3 3,000 I. U., Vitamin E 15 I.U., B_{12} 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 B_1 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, Selenium0.1 mg, BHT (Antioxidant) 100 mg, Zinc Bacitracin 10 mg*

Three birds per replicate were randomly selected and transferred to metabolic cages for five days adaptation period and four days total collection of the droppings. The droppings were oven dried, bulked and representative samples were taken for chemical analysis. The percentage of the nutrients retention was estimation according to [9] methods.

2.6.2 Carcass and organ weight measurements

At the end of the feeding experiment, 4 chicks from each treatment were randomly taken and slaughtered. Liver, heart, pancreas, gizzard and abdominal fat were removed and weighed. The dressed and organ weights were expressed as the percentage of final body weight.

2.7 Chemical Analysis

Samples of experimental diets and faecal droppings were analyzed on dry matter basis for proximate composition according to [10] procedures.

2.8 Statistical Analysis

Data obtained were subjected to analysis of variance (ANOVA) using SPSS version 20.0 for windows. Statistical means were separated using least significance difference [11].

3. RESULTS AND DISCUSSION

The results of daily feed intake did not differ (P>0.05) among the treatment groups (Table 2). The final body, average body weight gain and feed conversion ratio of the birds were similar (P>0.05) across the treatments but superior in birds on 5% diet compared with those on 0, 10, 15 and 20% TDSM diets. Mortality was not influenced by increasing levels of TDSM in the diets. The non (P>0.05) significant final body weight, body weight gain, feed intake and FCR is an indication that the TDSM is a good plant protein source for substitution in broiler ration. However, the inclusion of TDSM at 10-20% substitution levels decrease growth performance with no significant (P>0.05) differences among the other groups. These results are in agreement with those reported by [5,12] who reported that TDSM could be used successfully as a plant protein to replace groundnut cake in broiler diets. The results of the growth performance and feed conversion ratio in this study are higher and superior to earlier study by [5,12]. The best feed conversion ratio (2.24) was recorded in diet 2 (5% inclusion level of TDSM). This result is in agreement with [5] who reported the best feed conversion ratio (2.09) in diet fed 2.5% inclusion level of toasted *Daniella oliveri* seed meal. The differences in growth performance and feed conversion ratio in this findings compared with previous study [12] could be due to differences in the strain of broiler chicks (Marshal against Arbor Acre broiler chicks) and protein source (groundnut meal against soybean meal). The growth performance and feed conversion ration of birds on 5% TDSM conform to those reported by [5].

The cost of feeds was considerably reduced with the inclusion of TDSM in the broiler diets as summarized in Table 2. The inclusion of TDSM in the broiler diets at the levels of 5-20% significantly (P<0.05 reduced the cost/kg diet thereby reducing the cost of feeding. As a result, the highest feed saving cost/bird was obtained at 20% TDSM inclusion level and decreasing at 5%. The cost per kg gain of birds decreased with increasing TDSM in the diets, because the seeds were obtained from rural areas at no cost but processed with low cost.

The faecal nutrient digestibility of dry matter, crude protein, crude fibre, fats and ash contents of birds fed 0 and 5% TDSM diets showed high digestible values compared with increasing inclusion levels (10, 15 and 20%) (Table 3). The highest dry matter, crude protein, ash, crude fibre and fat digestibility of birds fed 5% inclusion level of toasted *Daniellia oliveri* seed meal conforms to those reported by [13] for roasted Pride of Barbados seed meal while the lowest was recorded by birds on 20%. This result negates the findings of [5] who reported the highest nutrient digestibility in broilers fed 2.5% toasted Daniella seed meal.

The percentage of dressed weight, liver, heart, gizzard, pancreas and abdominal fat were not affected by TDSM protein substitution with SBM in the diets (Table 4). This finding is in agreement with previous reports by [13,14,15] who fed broilers with whole grains of wheat and hungry rice.

Table 2. Performance of broiler chicks fed toasted *Daniellia oliveri* seed meals

Parameters	Toasted *D. oliveri* seed meal inclusion levels (%)					SEM
	0.0	5.0	10.0	15.0	20.0	
Initial body wt. (g/bird)	40.00	40.00	40.01	40.03	40.01	0.01
Final body wt. (g/bird)	2043.00	2050.00	2034.60	2030.00	2028.00	23.00
Body wt. gain (g/bird)	2003.00	2010.00	1994.59	1989.97	1988.00	21.11
Daily wt gain (g/bird)	35.76	35.89	35.62	35.54	35.50	2.30
FeedIntake (g/day/bird)	80.82	80.33	80.80	80.66	80.50	1.79
Feed conversion ratio	2.26	2.24	2.27	2.27	2.27	0.51
Mortality (%)	6.67	-	3.33	-	6.67	0.00
Cost of feed/Kg diet, (₦)	95.00^{a}	82.63^{b}	77.67^{c}	65.00^{d}	63.12^{d}	6.19
Cost of feed intake /bird (₦)	429.96^{a}	371.71^{b}	351.44^{b}	293.60^{c}	284.54^{c}	5.35
% feed saving cost/bird (₦)	-	13.55	18.26	31.71	33.82	-

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

Table 3. Faecal nutrients digestibility of finisher broiler chicks fed toasted *Daniellia oliveri* seed meals (% DM basis)

Ingredients	Experimental treatments					SEM
	0.0	5.0	10.0	15.0	20.0	
Dry matter	84.54	86.65	83.51	80.70	80.44	1.56
Crude protein	88.7	89.50	81.90	77.62	75.70	2.41
Crude fibre	72.00	74.90	71.62	68.80	69.60	1.49
Fats	70.40	70.87	70.90	70.53	68.30	0.84
Ash	75.3	72.03	72.70	71.06	70.00	1.03

Table 4. Dressed and organ weights of finisher broiler chickens fed graded levels of *Daniellia oliveri* seed meals

Parameters	Experimental treatments					SEM
	0.0	5.0	10.0	15.0	20.0	
Dressed weight (%)	74.30	75.00	73.60	73.50	74.00	1.56
Liver (%)	2.12	2.40	2.05	2.08	2.07	0.60
Heart (%)	0.48	0.50	0.47	0.47	0.46	0.01
Pancreas (%)	0.26	0.27	0.25	0.25	0.24	0.19
Gizzard (%)	2.52	2.67	2.42	2.44	2.40	0.71
Abdominal fat (%)	1.60	1.32	1.12	1.03	1.07	0.12

4. CONCLUSION

The results obtained are indicative of absence of pathological abnormalities such as liver and kidney failure and toxicity. The results revealed a lower cost of broiler production with increasing TDSM in the diets and high saving cost. Therefore, the use of boiled TDSM in broiler diets up to 20% is recommended.

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 College of Wildlife Management, New Bussa, Niger State, Nigeria.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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