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Neem (*Azadirachta indica*) Seed Cake in the Diets of Cockerel Chickens

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Abstract: The response of cockerel chickens fed graded levels of untreated and treated neem seed cake as partial replacement of Soya Bean Meal (SBM) was investigated. A total of 180 cockerels were subjected to an 8 week feeding trial in a 3x2 factorial design. There were 6 dietary treatments: diets 1 and 2 contained Untreated Neem Seed Cake (UNSC) at 10 and 20%, diets 3 and 4 contained Water Soaked Neem Seed Cake (WNSC) at 10 and 20% levels while diets 5 and 6 contained Charcoal supplemented Neem Seed Cake (CNSC) at 10 and 20% each replacing soyabean meal. The charcoal in diets 5 and 6 was added at a dose of 4 kg/tonne of feed. Results obtained showed that Feed Intake (FI), Body Weight Gain (BWG) and Feed Cost per kilogram Weight Gain (FCWG) were significantly different ($p<0.05$) across the treatments while feed gain ratio and feed cost did not show any difference among treatment means. Cockerels on WNSC diets had higher FI and BWG while those on UNSC had the least values. FCWG was similar in WNSC and CNSC and was better ($p<0.05$) than UNSC. Cockerels fed UNSC based diets produced least result in nearly all the carcass indices measured. Bigger breast plate, thigh, drumstick and back parts ($p<0.05$) were observed for birds on WNSC diets up to 20% level of inclusion. Blood parameters did not show any significant differences ($p>0.05$) among dietary treatments. It is concluded that treated neem seedcake may replace part of SBM used in the diet of cockerel chickens at the levels studied.

Key words: Feed resources, improvement technique, poultry, neem seed cake

INTRODUCTION

The world demand for additional protein supply for the increasing population has encouraged the studies and exploitation of various inedible protein-rich by products. Over the past two to three decades, there has been a significant upsurge of interest in the use of fodder trees and shrubs as source of protein and other nutrients for the non-ruminants. However, the current trend in high cost of feed with irregular supply of feedstuffs which pose a great threat to the future of livestock industry is an indication that research attempts have not match up with different challenges of feeding farm animals. A steady supply of low cost feed is essential in the quest to improve productivity of animal (Sonaiya, 1990). It therefore becomes very imperative to intensify efforts in search for cheaper, abundant and locally available alternatives that has little or no dietary value to man (Odunsi *et al*., 2002) for a sustainable production. This search should be logically harnessed towards poultry that depend to a larger extent on compounded feed (Longe and Fagbenro-Byron, 1989) but are quite simple to raise, prolific and economical to bridge man's need for animal protein.

Neem (*Azardirachta indica)* seed cake obtained from neem seed oil industry is a potential alternative source of non-conventional feedstuff. Information available on Neem plant (*Azardirachta indica)* indicated that it is the only species in the genus *Azardirachta*. It is native to India and Burma, growing in tropical and semitropical regions (Ramesh, 2000) and span for many years. A full-grown tree can produce 30-100 kg fruit depending on rainfall soil type and ecotype. 50 kg of fruits yield 30 kg of seed giving 6 kg of oil and 24 kg of seed cake (Ramesh, 2000). Its medicinal properties are well documented making it a desirable tree plant. According to Ketkar (1976), Neem seed cake contained 3.56% nitrogen, 0.83% phosphorous and 0.77% calcium. The protein in the cake is relatively balanced in its amino acid and mineral profiles. However, the use of neem seed cake as feedstuff was discouraged because of the presence of bitter and toxic triterpenoids, mainly nimbin, nimbidin, azadirachtin and salanin (Paul *et al*., 1996). It was also reported that feeding of such ingredient might impart unpleasant taste or smell on the meat (Clausen *et al*., 1985). Attempts have been made to detoxify and to reduce bitterness of the cake for animal use through solvent extraction, water washing, alkali soaking, urea-ammunition and autoclaving (Gowda *et al*., 1998; Uko and Kamalu, 2006; Bawa *et al*., 2007). Soaking in water and addition of charcoal would therefore add to the existing methods of detoxification and palatability enhancement. The cost of processing the seed or cake becomes a factor to consider in practical livestock feeding. This study focused on the use of simple and low cost improvement technique to evaluate performance, carcass and haematological qualities of cockerel chickens fed treated and untreated neem seed cake based diets.

MATERIALS AND METHODS

Seed collection and preparation: The neem seeds were collected in batches during fruiting season (May-July) at locations within Ogbomoso, Nigeria. The collected seeds were sun dried to constant weight and weighed. Parts of the dried seeds were soaked in water in an open basin for 72 h. The seed were poured into a jute bag to drain the water and later sun-dried to constant weight. Then, the water soaked and untreated seeds were taken to the mill separately for oil extraction. Cake obtained from the oil-extraction was then ground in a hammer mill to pass through 2 mm sieve. Neem seed cake meal was incorporated into diets of cockerel chickens as Water Soaked Neem Seed Cake (WNSC) and Untreated Neem Seed Cake (UNSC).

Experimental diets: Six diets were formulated. Diets 1 and 2 containing Untreated Neem Seed Cake (UNSC) at 10 and 20%, Diets 3 and 4 contained Water Soaked Neem Seed Cake (WNSC) at 10 and 20% while diets 5 and 6 contained wood Charcoal supplemented Untreated Neem Seed Cake (CNSC) at 10 and 20%. Each level of inclusion replaced part of Soya Bean Meal (SBM) as a source of protein in a typical reference diet. Charcoal was added to diets 5 and 6 at the rate of 4 kg/ tonne. Other ingredients as contained in the gross composition is as shown in Table 1.

Experimental birds and management: A total of 180 day-old Harco cockerels were randomly allocated to 6 treatment groups with 3 replications of 10 birds each. The design of the experiment was a 3x2 factorial lay out i.e., 3 treatments (untreated, soaked and charcoal supplemented) and 2 replacements at 10 and 20% inclusion levels. The birds were housed on floor brooder with wood shaving throughout the 8 weeks of the experiment. Feed and water were given *ad libitun*. Feed intake and live weight measurement were taken weekly to determine weight gain ratio while current market price was used for the economic analysis. Cost per kg of feed was calculated from the costs of various ingredients used in the ration formulation. Cost per kg weight gain was determined by multiplying cost per feed by feed-gain ratio.

Carcass and blood analysis: Four birds were randomly selected per treatment (i.e., 2/replicate) for carcass cuts and organ examination at the expiration of the experiment having withdrawn feed for 12 h. Weight of organs and various parts were taken and expressed as percentage of the final live weight of the birds. Blood samples meant for haematological analyses were drawn from the wing veins of the selected experimental birds and collected in Ethylene Diamine Tetra-Acetate (EDTA) bottles. Packed Cell Volume (PCV), Haemoglobin concentration (Hb), Red Blood Cell (RBC) were determined using Wintrobes microhaematocrit, colorimetric cyanomethaemoglobin method and improved Neubauer haemocytometer, respectively (Lamb, 1991) and others such as leucocytes, neutrophil and lymphocytes were analyzed as described by Jain (1986).

Table 1: Proximate composition of untreated and water soaked neem seed cake

Constituent (%)	Untreated neem seed cake	Water soaked neem seed cake
Dry matter	89.26	89.74
Crude protein	14.24	17.48
Crude fibre	17.26	19.59
Ash	8.21	9.82
Ether extract	3.86	4.12
Nitrogen free extract	45.69	38.73
Gross energy (kcal/kg)	3252	3148

Chemical and statistical analysis: Proximate composition of the diets and test ingredients were determined by standard method of AOAC (1990). Following the experimental design of a 3x2 factorial arrangement, data obtained were subjected to two-way analysis of variance in a completely randomized design using SPSS (1999). Significant means were separated, using a Least Significant Differences designed by Fisher as outlined by Wahua (1999).

RESULTS

The crude protein content of treated neem seedcake was higher than those obtained for untreated neem seed cake while the energy value was lower in the former. Protein content of the diets ranges between 20.94 and 21.25% with WNSC based diet having the highest values (Table 1).

The performance of cockerels fed untreated and treated neem seed cake based diets is shown in Table 2. Feed intake, weight gain and feed cost per kilogram weight gain showed significant differences ($p<0.05$) across the treatments. UNSC, WNSC and CNSC did not impose significant changes ($p>0.05$) on feed gain ratio and feed cost at the 2 levels of inclusion. Improved weight gain and feed consumption were evident ($p<0.05$) in WNSC at 10, 20 and 10% of CNSC. The summary of the single effect of treatments on performance is as shown in Table 3. No significant difference ($p>0.05$) was observed for the single effect of treatments on performance indices measured except for feed cost per kilogram weight gain, which was better ($p<0.05$) in WNSC and CNSC than UNSC dietary treatment.

The result of carcass and organ characteristics (Table 4) showed that the back, drumstick and thigh parts were significantly bigger ($p<0.05$) in 20% WNSC compared to CNSC and UNSC treatments. The breastplate part was notably smaller in UNSC particularly at 20% level. Head, neck, shank and wing did not show significant

Table 2: Gross composition of experimental diets (%)

	UNSC (%)		WNSC (%)		CNSC (%)	
Ingredients	10	20	10	20	10	20
Fixed ingredients*	82.0	82.0	82.0	82.0	82.0	82.0
Soya bean meal	16.2	14.4	16.2	14.4	16.2	14.4
Neem seed cake	1.8	3.6	1.8	3.6	1.8	3.6
Charcoal	-	-	-	-	0.40	0.40
Determined contents (%)						
Dry matter	90.6	91.4	92.1	90.8	90.7	91.9
Crude protein	21.4	20.7	21.4	20.9	21.4	20.7
Crude fibre	4.34	4.65	4.38	4.73	4.38	4.97
Ash	3.23	3.56	3.65	3.78	4.12	4.23
Ether extract	5.01	5.11	5.34	5.28	5.07	5.14
Nitrogen free extracts	56.6	57.4	59.3	56.1	56.7	56.9
**Metabolizable Energy (kcal/kg)	2831.9	2849.5	283101	2823.1	2831.1	823.1

*Fixed ingredients contains (%): maize, 50.0; wheat offal, 15.3; groundnut cake, 10.0; fish meal, 3.0; oyster shell, 1.0; bone meal, 2.0; salt, 0.25; methionine, 0.20 and premix, 0.25. **Calculated and devoid of values from NSC

Table 3: Performance of cockerels fed treated and untreated neem seed cake based diets

	UNSC (%)		WNSC (%)		CNSC (%)		
Parameters	10	20	10	20	10	20	SEM
Feed intake (g)	42.6^{ab}	41.4^{b}	44.8^{a}	42.5^{ab}	42.6^{ab}	40.7^{b}	0.91
BWG (g/b/d)	7.03^{ab}	6.83^{b}	7.66^{a}	7.35^{a}	7.37^{a}	7.00^{ab}	0.14
Feed/gain ratio	6.06	6.06	5.84	5.71	5.87	5.83	0.14
Feed cost/ kg (#)	40.4	40.0	40.6	40.2	40.5	40.1	0.14
Feed cost/ kg BWG (#/kg)	245.1^{a}	242.4^{a}	237.2^{ab}	229.4^{b}	237.7^{ab}	233.5^{b}	4.6
	*UNSC		*WNSC		*CNS^{C}		
Feed intake (g)	41.9		43.6		41.6		
BWG (g/b/d)	6.93		7.51		7.19		
Feed/gain ratio	6.06		5.78		5.85		
Feed cost (#)	40.2		40.4		40.3		
Feed cost/ kg BWG #/kg)	243.7^{a}		233.3^{b}		235.6^{b}		

^{ab}Means bearing different superscript in the same row differ significantly ($p<0.05$) *Single effect of treatment SEM: Standard Error of Means

Table 4: Carcass and organ characteristics of cockerels fed treated and untreated neem seed cake based diets

Parameters/	UNSC (%)		WNSC (%)		CNSC (%)		
Carcass (%)	10	20	10	20	10	20	SEM
Head	10.8	10.2	10.3	10.8	9.32	9.55	0.39
Neck	8.65	10.7	11.9	11.4	11.0	9.99	0.74
Shank	11.2	11.9	11.0	12.8	11.5	11.2	0.44
Back	24.8^{b}	22.4^{b}	20.6^{ab}	31.7^{a}	24.7^{b}	22.3^{b}	2.23
Wing	18.1	16.7	18.4	21.9	18.3	18.5	1.11
Drumstick	18.2^{ab}	15.3^{b}	21.3^{ab}	23.5^{a}	20.2^{ab}	18.6^{ab}	1.83
Thigh	15.3^{b}	15.9^{b}	18.3^{ab}	20.8^{a}	18.3^{ab}	16.4^{ab}	1.33
Breast	23.6^{b}	15.7^{c}	27.2^{ab}	31.8^{a}	26.2^{b}	24.8^{b}	3.43
Organ (%)							
Lung	1.37	1.31	1.45	1.77	1.27	1.26	0.12
Kidney	1.96	1.97	2.16	2.20	1.70	1.89	0.12
Heart	0.79	1.15	1.24	1.37	1.10	0.96	0.13
Spleen	0.40	0.39	0.53	0.39	0.38	0.41	0.05
Liver	6.07	6.16	5.28	7.20	5.47	6.31	0.46
Proventriculus	0.97	1.42	1.23	1.44	1.36	0.99	0.44
Gizzard	11.4	12.4	12.6	14.1	11.9	10.0	1.04

^{ab}Means bearing different superscript in the same row differ significantly ($p<0.05$), SEM: Standard Error of Means

differences ($p>0.05$). None of the organs (lung, kidney, heart, spleen, liver, proventriculus and gizzard) showed significant differences ($p>0.05$) across the treatments. Table 5 reveals the single effect of treatments on carcass and organ characteristics. It indicated that WNSC was superior ($p<0.05$) over the UNSC but not significantly different ($p>0.05$) from CNSC in terms of back, drumstick, breastplate and thigh carcass cut regions.

All haematological indices measured in this study (PCV, WBC, Haemoglobin and erythrocytes indices) are similar across the treatments (Table 6).

DISCUSSION

Soaking in water is a better improvement technique as reflected in higher values obtained for crude protein and ether extract content of the cake. The result corroborates the findings of Nath *et al.* (1983) who reported that soaking of the seed improved the crude protein content and palatability of the cake. This means that soaking of neem seed is a better improvement technique than autoclaving that lowered crude protein content of the seed (Uko and Kamalu, 2006). Slight decline in gross energy content obtained for WNSC is probably due to loss of some soluble part of the seed in water during soaking.

Untreated neem seed cake has been reported for its pungent smell and unpalatability, which depressed feed consumption and adversely affected growth (Nath *et al.*, 1974). Improved consumption of WNSC based diets as observed in both the treatment effects and inclusion levels compared to other treatments may be attributed to the reduction of water soluble bitter components like nimbin and nimbidin during soaking. Decline in feed intake in CNSC may be linked to poor presentation of the feed due to its blackish colour in addition to its bitter taste and unpleasant sulphur odour due to presence of certain alkaloids in the seed (Nath *et al.*, 1983; Elangovan *et al.*, 2000). The positive effect of wood charcoal supplement as an adsorbent manifested in birds fed 10 and 20%, which resulted in higher weight gain similar to that of WNSC despite its low feed intake. This implies that wood charcoal could be an effective adsorbing agent of anti nutritive factors of feed preventing tissue depletion in experimental birds. This is in consonance with the study conducted by Kutlu *et al.* (2001) who reported that wood charcoal inclusion improved performance of broiler chickens during the first 4 weeks of age. It was also reported that activated charcoal adsorbs toxins and enhances the intake of poisonous plants (Poage *et al.*, 2000). According to Nath *et al.* (1983), the principal growth-retarding factors of neem seed cake were believed to be water-soluble. This may explain the reason for a significant weight gain noted with WNSC over the UNSC treatments at the two levels of inclusion.

Feed cost per kilogram weight gain of the improvement techniques revealed that soaking of neem seed cake in water is the most cost effective followed by CNSC in addition to their practicality and simplicity. The marginal rise in feed cost noted with WNSC is due to labour costs accrued from soaking and sun drying. While the adsorption therapy with charcoal as non-digestive carrier is an important method of preventing the ingested toxicant or noxious substances formed in the gastro intestinal tract (Mahipal and Mahajan, 1994), the physical presentation of the feed appeared to have contributed to its low feed consumption.

For carcass quality indices, cockerels fed UNSC based diets recorded low values in nearly all parameters measured compared to those on treated NSC diets. The thigh, drumstick, breastplate and back parts were particularly bigger in WNSC treatment group, meaning that soaking of NSC improved dressing percentage of the experimental birds and will be a better improvement technique for NSC.

The hematological values were within the normal levels reported for chickens (Mitruka and Rawnsley, 1977). This indicated that at the levels of inclusion 10 and 20% NSC, treated or untreated did not have any adverse affect

Table 5: Summary of single effect of treatment on carcass and organ characteristics

Parameters (%)	UNSC	WNSC	CNSC
Head	10.5	10.5	9.44
Neck	9.66	11.6	10.5
Shank	11.6	11.9	11.3
Back	23.4^{b}	28.6^{a}	23.5^{b}
Wing	17.4	20.2	18.4
Drum stick	16.7^{b}	22.4^{a}	19.4^{ab}
Thigh	15.6^{b}	19.6^{a}	17.4^{ab}
Breastplate	19.6^{b}	29.5^{a}	24.5^{ab}
Organs (%)			
Lung	1.34	1.61	1.27
Kidney	1.97	2.18	1.8
Heart	0.97	1.31	1.03
Spleen	0.4	0.46	0.4
Liver	6.12	6.24	5.89
Proventriculus	1.2	1.34	1.18
Gizzard	11.9	13.3	10.9

^{ab}Means bearing different superscript in the same row differ significantly ($p<0.05$)

Table 6: Haematological indices of cockerel fed treated and untreated NSC diets

	UNSC (%)		WNSC (%)		CNSC (%)		
Parameters	10	20	10	20	10	20	SEM
Haemoglobing/dl	8.65	8.55	8.4	8.3	7.98	8.4	0.15
PCV (%)	26.0	25.8	25.3	25.0	23.5	25.3	0.57
RBC g/dl	4.28	4.35	4.2	4.15	3.83	4.23	0.12
WBC mm3	5.08	5.48	6.53	5.20	5.38	5.78	0.34
MCV (µ3)	60.8	59.3	60.1	60.3	64.5	59.7	1.21
MCH (Fmg)	3.33	3.32	3.33	3.32	3.32	3.33	0.004
MCHC (%)	202.5	196.9	200.4	200.0	203.9	198.8	1.63
Neutrophils	51.8	49.3	51.7	52.8	45.8	46.5	1.91
Lymphocytes	42.0	42.5	40.3	42.5	45.5	45.5	1.34
Eosinophils	5.00	5.50	5.00	3.00	4.75	5.25	0.58
Monocytes	1.25	2.75	2. 50	1.75	4.00	3.25	0.63

on the functions of the cells and organs of the cockerel chickens. It could also be said that the like hood of long term effect or residual effect on the meat was not manifested. Organ characteristics are further evidence revealing that anti nutritive factor in NSC at the level of inclusion did not jeopardize the normal functioning of the organs. There were no significant differences across the treatments possibly because the inclusion levels studied were tolerable and that the heat during oil extraction might have substantially reduced toxic substances of the cake.

Conclusion: It can be concluded that treated neem seedcake could be used as feed ingredient in poultry diet. Soaking of the neem seed cake in water and charcoal supplementation were, even at 10 and 20% soyabean meal replacement levels, better and cost effective improvement techniques. The adsorbent nature of charcoal as non-digestive carrier prevented the ingested toxicant to interfere with the performance characteristics of cockerels while the physical presentation of the feed needs to be considered.

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