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Performance and nutrient digestibility of broiler chickens fed graded levels of fermented and toasted *Albizia lebbeck* seed meal

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Abstract

This study was conducted to investigate the effects of fermented and toasted Albizia lebbeck seed meal (FTALSM), on the growth performance and nutrient digestibility of broiler chickens at the starter and finisher phases. One hundred and fifty (150) day old chicks (Abo acres) were used for this study and were divided into five treatments (with three replicate each containing 10 birds) using a completely randomized design (CRD) for eight weeks. The treatments were five diets containing 0% (control), 5%, 10%, 15% and 20% of fermented and toasted Albizia lebbeck seed meal (FTALSM), respectively and were tagged Diet 1, 2, 3, 4 and 5. The diets were formulated to be isocaloric and isonitrogenous. The feed intake at the starter phase was significantly higher ($p<0.05$) in Diets 3 and 4 which had 10 and 15% inclusion of FTALSM, respectively. Diets 2, 3 and 4 also differ significantly ($p<0.05$) in final body weight and total weight gained from the control diets. The results at the finisher phase indicated that, there were significant differences ($P<0.05$) in all the parameters measured except for mortality. Birds fed Diet 2 performed significantly better in weight gain (1453g) and feed intake (3087.25g) compared to the control group. Birds on the control and Diet 2 had similar feed efficiency, the values were however, better than those on the other treatments. The results of nutrient digestibility showed birds fed Diet 5 (20% FTALSM) recorded significantly ($P<0.05$) low digestibility values in all parameters measured. The results showed that fermentation and toasting reduced phytase, oxalate and cyanide by 41.87, 26.67 and 99.94 % respectively. It can be concluded therefore, that FTALSM can be included up to 15 % in broiler chickens starter diets and 5 % in the finisher diet for optimum growth performance.

Keywords: Performance, Broiler Chickens, Albizia lebbeck Seed

Introduction

Feed accounts for 70 – 80% of the total cost of broiler production in Nigeria (Ademola and Farinu, 2006). This has invariably escalated the prices of poultry products out of the reach of the common populace and a resultant drop in animal protein intake. The replacement of expensive conventional feed ingredients particularly those of protein origin (soybean and groundnut cake) with cheap, locally available and non-human competitive substitutes in feed formulation represents a suitable strategy at reducing the total feed cost of poultry production in Nigeria. The cost of conventional protein and energy sources such as groundnut meal, soya bean meal, fish meal and maize for non-ruminant animals in many tropical countries have been on the increase, such that it is uneconomical to use these conventional feedstuffs in poultry feeds (Oduguwa *et al.* (2004), Esonu *et al.* (2004). The option has been to source for locally available and cheap plant materials such as *Albizia lebbeck* to formulate a balanced ration for non-ruminants particularly poultry from non-conventional feed resources. One possible source of cheap and available non-conventional feed ingredient is ***A**lbizia*

lebbeck seeds meal which may serve as protein concentrate in rations having a CP content of 23.4 with some anti-nutritional factors (tannin, saponin, theobromine, hydrocyanide). The use of *Albizia lebbeck* in monogastric nutrition is limited by the presence of anti-nutrients such as saponin, oxalate, phytate, tannin and cyanide (Muhammad *et al.*, 2010). It therefore requires fermentation and heat treatments to remove the anti-nutrients which accentuate digestive losses. This study was conducted to investigate the effects of fermented and toasted Albizia lebbeck seed meal (FTALSM), on the growth performance and nutrient digestibility of broiler chickens at the starter and finisher phases. Esonu *et al*. (1997) reported that most leguminous seeds are thermo-stable and therefore need more than one treatment methods. Toasting, fermentation and boiling are some of the methods used by different authors to remove or reduce the anti-nutrients. Fermentation processes using *Aspergilli* have been used to improve the nutritive value of some feed stuffs such as soya bean (Mathivanan *et al.,* 2006; Yamamoto *et al.,* 2007). The desirable characteristics of the fermented products include their acceptability by birds (Nagra *et al.,* 1998) and nutrient availability (Hong *et al.,* 2004).

Materials and methods

This research work was carried out at the poultry section of the Teaching and Research Farm of the Department of Animal Production, Bosso campus, Federal University of Technology, Minna, Niger State. Nigeria. Five (5) experimental diets were formulated using maize, soyabeans meal, groundnut cake, fish meal, bone meal, limestone, salt, rice bran, palm oil, vitamin/mineral premix, lysine, methionine as feed ingredients. The proximate composition of raw, fermented and toasted *Albizia lebbeck* seed meal was carried out Table 1.

Table 1: Proximate composition of raw, fermented and toasted *Albizia lebbeck* Seed (%)

Nutrients	RALSM	FTALSM	% CHANGE
Moisture content	3.46	6.17	78.32
Crude protein (CP)	23.45	22.93	2.22
Crude fibre (CF)	18.00	16.67	7.39
Ash	2.00	6.40	220
Oil extract	5.00	10.50	110
Nitrogen free extract (NFE)	48.09	37.33	22.37

RALSM – Raw *Albizia lebbeck* seed meal
FTALSM – Fermented and Toasted *Albizia lebbeck* seed meal

Fermented and toasted *Albizia lebbeck* seed meal (TFALSM) was used at inclusion levels of 0, 5, 10, 15, and 20% in Diets 1, 2, 3, 4 and 5, respectively to replace groundnut cake with Diet 1 as the control diet Tables 2 and 3. The experimental design was completely randomized design (CRD). One hundred and fifty (150) birds were allotted to five (5) dietary treatment groups with three (3) replicates each. Each dietary treatment contained thirty (30) birds with ten (10) birds per replicate. The birds were reared on a deep litter intensive management system. The experiment lasted a period of eight (8) weeks. The procedure for the fermentation of corn-cob as described by Adeyemi and Familade (2005) was used for the fermentation of the seeds. Water was sprinkled on the seeds at the ration of 3:1 and a big plastic polythene bag was then placed in a plastic drum and the wet *Albizia lebbeck* seeds were placed inside a polythene bag, tied and secured with a rope to make it air tight, therefore, preventing exchange of gasses between the fermenting material and the environment

for 48hours (anaerobic fermentation). The fermented *Albizia lebbeck* seeds were sun dried on polythene sheets spread on concrete platform to prevent contamination. After drying, the seeds were toasted using the local groundnut processing method. This involved putting sand and the seeds in a large frying pan over a naked flame and stirred continuously until the color of the seeds were changed to dark brown and having an appetizing aroma. The product was then spread on the cement floor and ground using a hammer mill of 2 mm disc diameter before incorporation into formulation of the ration on weight for weight substitution with groundnut cake. The initial weights of the chicks were taken at the beginning of the experiment by weighing all the chicks in each replicate together, and dividing by the number of the birds. Subsequently, the average weekly body weight gain was obtained by subtracting the body weight of the previous week from the weight of the present week. Digestibility trial was conducted on two (2) birds selected from each replicate at week eight of the feeding trial to assess the level of nutrient digestibility. The birds were housed in metabolic cages for a four days adjustment period and droppings were collected for four days. Feed was given *ad-libitum* and left over feed were weighed before offering fresh feed and the droppings were collected separately from each replicate during the four days collection period. The droppings were weighed, wrapped in aluminum foil, oven dried at 80°C and re-weighed until a constant weight was obtained using the method of McDonald *et al.* (2010). The collections from each of the replicates were pooled after drying and mixed thoroughly and 10g was used for proximate analysis. The percentage apparent digestibility of dry matter, Crude protein, Crude fibre, ash, Ether extract and nitrogen free extract was computed individually using the formula described by Vogtmann *et al.* (1975). All data obtained on various parameters were subjected to one way Analysis of Variance (ANOVA) using SPSS (2007) version 20.0 while Duncan's Multiple Range Test (1995) was used to separate the means where there was statistically significant differences ($P<0.05$). The anti-nutritional factors analysis of the raw, fermented and toasted

Table 2: Percentage composition of broiler starter diets (%)

Ingredient	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Maize	52.20	50.79	49.36	47.96	46.52
Groundnut cake	18.90	16.65	14.40	12.15	9.90
Rice Offal	3.00	3.00	3.00	3.00	3.00
Soya bean meal	18.90	20.31	21.74	23.14	24.58
FTALSM	0.00	2.25	4.50	6.75	9.90
Palm oil	1.00	1.00	1.00	1.00	1.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.00	1.00	1.00	1.00	1.00
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Vit/Mineral premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100
Calculated analysis					
Crude Protein (%)	23.00	23.00	23.00	23.00	23.00
Metabolizable Energy (Kcal/kg)	2906.10	2903.15	2900.01	2897.16	2893.90

FTALSM – Fermented and Toasted *Albizia lebbeck* seed meal
Vitamin/Mineral premix - Composition

Albizia lebbeck seeds was carried out at the National Animal Production Research Institute (NAPRI), Zaria, Kaduna State. The proximate composition of the raw, fermented and toasted *Albizia lebbeck* seeds were also carried out according to the procedures of AOAC (1990). The diets and the droppings were analyzed for proximate composition.

Table 3: Composition of broiler Chickens finisher diet (%)

Ingredient (%)	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Maize	55.33	53.91	52.50	51.08	49.63
Groundnut cake	16.34	14.09	11.84	9.59	7.34
Rice Offal	3.00	3.00	3.00	3.00	3.00
Soya bean meal	16.34	17.75	19.16	20.58	22.03
FTALSM	0.00	2.25	4.50	6.75	9.00
Palm oil	3.00	3.00	3.00	3.00	3.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.00	1.00	1.00	1.00	1.00
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Vit/Mineral premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated nutrients					
Crude Protein (%)	21.00	21.00	21.00	21.00	21.00
Crude Fibre (%)	3.30	3.66	4.00	4.35	4.83
*M E (Kcal/kg)	3050.49	3047.19	3044.24	3041.20	3037.83

***Biomix^{R} Finisher supplied per Kg: Vit. A, 800 I.U.; Vit. D3, 1200 I.U.; Vit.E, 13 mg; Vit. K, 2mg;Riboflavin, 3 mg; Cobalamin, 10 mg; Folic acid, 1.5 mg; Biotin, 0.25 mg; Antioxidant, 125 mg; Fe, 25mg; Mn, 80mg; Zn, 50 mg; Cu, 2 mg; Co, 0.2 mg and Se, 0.1 mg.**
FTALSM- Fermented and Toasted *Albizialebbeck*

Results and Discussion

Table 4 shows the laboratory analysis of anti-nutritional factors in raw, fermented and toasted *Albizia lebbeck* seed meal. Fermentation and toasting led to 47.78 % increase of saponin content. The increase in the level of saponin is an indication that fermentation and toasting methods used are not the best processing methods of reducing saponin. However, fermentation and toasting decreased phytate, Oxalate and the cyanide contents by 41.87, 26.67 and 99.94% respectively. The general reduction observed in phytate, oxalate and cyanide in this study might be due to the effect of toasting and fermentation on *Albizia lebbeck* and this agreed with the findings of Esonu *et al*. (1997) that most leguminous seeds are thermo-stable and therefore need more than one treatment methods

Table 4: Anti-nutritional composition in raw, fermented and toasted *Albizia lebbeck* seed

Anti-nutritional factor	RALSM (%)	FTALSM (%)	% CHANGE
Saponin	0.90	1.33	47.78
Phytate	2.03	1.18	41.87
Oxalate	0.45	0.3 3	26.67
Cyanide	6.37	0.004	99.94

RALSM – Raw *Albizia lebbeck* seed meal
FTALSM – Fermented and Toasted *Albizia lebbeck* seed meal

Results of the performance of broiler starter chickens fed graded levels of fermented and toasted *Albizia lebbeck* seed meal during the first four weeks of starter phase and the finisher phase are presented in Table 5 and 6. The significant decrease ($p < 0.05$) observed as the level of inclusion increased after 5 % inclusion at both started and finisher phases in the values of feed intake was in line with the work of Olorunsanya et al. (2010) that as the level of the inclusion of *Albizia lebbeck* increases from 5% the feed intake reduces. However, birds fed 5-15 % inclusion of *Albizia lebbeck* seed meal diets recorded significantly ($p < 0.05$) higher values in feed intake over the control diets. This could mean *Albizia lebbeck* seed meal had a positive influence on palatability of the diets and hence, higher intake. The significant ($p < 0.05$) performance of birds fed 5-15 % of tested ingredient at both started and finisher phases over control diet in final body weight and weight gained might be as a result of the processing methods used (fermented and toasted) on *Albizia lebbeck* seed in the diet. This contradicted the work of Olorunsanya *et al*. (2010) that there was no significant difference in final body weight and weight gain of broiler chickens fed control diet and 5% inclusion level of toasted *Albizia lebbeck* seed meal. The reduction in the weight gained at 20% inclusion could mean *Albizia lebbeck* required for the optimal performance was attend before 20 % inclusion level. This might be as a result of the amount of anti-nutrient (saponin) presence. This was in agreement with Olorunsanya *et al*. (2010) that birds fed high inclusion levels of toasted *Albizia lebbeck* seed meal had reduced feed intake. Liener (1989) and Bate-Smith (1973) reported that saponins affect feed intake and digestion. This implies that the dietary level of fermented and toasted *Albizia lebbeck* seed meal (FTALSM) beyond 15% does not support growth of the broiler chickens at both started and finisher phases. The insignificant level of mortality rate observed by the birds at both started and finisher phases was in contrast with the study of Olorunsanya *et al.* (2010) on significant differences ($p<0.05$) in mortality rate of the birds. Their result showed that as the level of inclusion of *Albizia lebbeck* increased the mortality rate also increased. The low mortality rate observed in this study might be as a result of the two treatment methods that were applied on the test ingredient (fermentation and toasting). The present study showed that fermentation and toasting of *Albizia lebbeck* seed was more effective in eliminating the ant-nutritional factors in the *Albizia lebbeck* seed

Table 5: Performance of broilers chicken (starter) fed graded levels of fermented and toasted *Albizia lebbeck* seed meal

Parameters	Diet 1 0 %	Diet 2 5 %	Diet 3 10 %	Diet 4 15 %	Diet 5 20 %	SEM	L.S
Initial weight (g)	50.33	50.33	50.67	50.67	50.33	0.13	ns
Final weight (g)	370^{b}	556.67^{a}	536.67^{a}	503.33^{a}	340^{b}	24.57	*
Average gain (g)	319.67^{b}	506.33^{a}	486^{a}	452.67^{a}	289.67^{b}	24.55	*
Feed intake (g)	909.61^{c}	1126.47^{b}	1210.12^{a}	1206.60^{a}	1056.23^{b}	31.18	*
F C R	2.85^{a}	2.23^{a}	2.49^{a}	2.68^{a}	3.70	0.01	*
Mortality %	0.00	0.03	0.03	0.00	0.03	0.04	ns

^{abc}**Means with the sa me superscripts are not significantly (p>0.05) different**

F C R Feed conversion ratio

NS=No significant difference (p>0.05)

SEM= Standard error of means

LS= Level of significance

***=Significant**

Table 6: Performance of broilers fed graded levels of fermented and toasted *Albizia lebbeck* seed meal at finisher phase (grams)

Parameters	Diet 1 0%	Diet 2 5%	Diet 3 10%	Diet 4 15%	Diet 5 20 %	SEM	L S
Initial weight (g/bird)	460.27	461.31	4546.42	455.19	466.33	1.164	*
Final weight (g/bird)	1500.00^{d}	2010.00^{a}	1613.00^{b}	1570.00^{c}	887.06^{e}	96.524	*
Body weight gain (g/bird)	1039.66^{d}	1548.69^{a}	1158.71^{b}	1114.81^{c}	420.67^{e}	97.150	*
Feed intake (g/bird)	2364.04^{d}	3087.25^{a}	2952.37^{b}	2785.00^{c}	2214.17^{e}	90.070	*
Feed efficiency (%)	43.97^{b}	50.16^{a}	39.24^{d}	40.02^{c}	18.99^{e}	2.861	*
Mortality (%)	0.00	0.03	0.00	0.03	0.00	0.00	ns

^{abc}Means in the same row with different superscript are significantly different (P<0.05), means with the same superscript are nsignificantly different (P>0.05).
SEM= Standard error of mean.
*** = significant difference**
LS= Level of significance
NS= No significant difference (P>0.05).

The result of nutrient digestibility trial of birds fed graded levels of fermented and toasted *Albizia lebbeck* seed meal is shown in Table 7. The result generally showed high digestibility of the diet and significant differences (P<0.05) were observed among the parameters measured. This could be due to effects of the processing methods (Fermentation and Toasting). The result also showed that as the level of inclusion increased, the percentage digestibility reduces in all the parameters measured except in dry matter. This agreed with the findings of Abeke (2008) that monogastric animals unlike ruminants do not have the necessary enzymes for degrading cellulose.

Table 7: Apparent nutrient digestibility of broiler chickens fed graded levels of fermented and toasted *Albizia lebbeck seed* meal at finisher phase (%)

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	SEM	LS
Dry matter	84.10^{a}	84.92^{a}	83.74^{ab}	83.45^{ab}	76.00^{b}	1.24	*
Ether extract	90.40^{a}	89.59^{a}	89.53^{a}	89.40^{a}	71.77^{b}	1.96	*
Crude protein	92.19^{a}	92.53^{a}	91.37^{a}	91.10^{a}	62.21^{b}	3.18	*
Crude fibre	85.77^{a}	85.74^{a}	85.44^{a}	84.83^{a}	81.11^{b}	0.53	*
Ash	93.08^{a}	93.66^{a}	93. 66^{a}	92.37^{a}	85.70^{b}	1.08	*
Nitrogen free extract	96.08^{a}	96.06^{a}	95.25^{a}	95.00^{a}	72.70^{b}	2.54	*

SEM= Standard error of mean.
* = significant difference
Means in the same row with different superscript are significantly different (P<0.05), means with the same superscript are not significantly different (P>0.05).
LS= Level of significance.

Conclusion

It is concluded based on the results of this study that broiler chickens at both starter and finisher phases can be fed up to 20% and 15 % inclusion of Fermented and Toasted *Albizia lebbeck* seed meal diets respectively for optimum growth performance. Therefore up to 20 % and 15 % inclusion into broiler starter and finisher chickens diet respectively is recommended.

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