13

NIGERIAN JOURNAL OF ANIMAL PRODUCTION

Published by

THE NIGERIAN SOCIETY FOR ANIMAL PRODUCTION

VOLUME 37 **2010 NUMBERS 1 & 2**

NIGERIAN JOURNAL OF ANIMAL PRODUCTION

The Nigerian Society for Animal Production was inaugurated in March 1973 during the first International Symposium on Animal Production in the Tropics at the University of Ibadan, Ibadan, Nigeria. This society is responsible for the publication of the Nigerian Journal of Animal Production which commenced publication in 1974. The Journal publishes two issues in a year. This present issue features the biography of two eminent personalities as a mark of honour to them.

Membership:
Membership of the society is open to all that are engaged or interested in any aspect of animal production including fisheries and wildlife management from all over the world. Interested individuals, organizations or institutions should apply for membership to the Secretary of the Society.

Subscription and Advertising:
The current annual subscription rate is N2,000 for non-members and N2,500 for organizations and institutions within the country. It costs one hundred and twenty eight US Dollars (US $ 128.00) for subscription outside Nigeria. Correspondence concerning subscriptions and purchase of single or back copies of the Journal should be addressed to the Deputy Editor-in-Chief, Nigerian Journal of Animal Production, Dr. O.A. Adeyemi, Department of Animal Production and Health, University of Agriculture, P.M.B. 2240, Abeokuta, Ogun State, Nigeria. *E-mail*: olajideadeyemi@yahoo.com,GSM: 08053031379

Manuscripts:
All manuscripts and correspondence concerning the journal should be sent to the Editor-In-Chief, Dr. A. A. Taiwo, Institute of Agricultural Research and Training, P.M.B. 5029, Moor Plantation, Ibadan. Oyo State., Nigeria. ***E. Mail:*** bttaiwo@ excite.com. Manuscripts are invited from all over the world as long as they are original research reports on any aspect of Animal Production and Health. All authors' name in the references must be in bold lower case letters except the first letter of each surname. The surname must be followed by the initials in all cases irrespective of the number of authors. Tables and legends for figures must be typed on separate sheets. Tables must be numbered, title written in lower case letter (except the first letter) and left justified. Horizontal and vertical lines within the tables are not acceptable. Submissions on computer compact disk (CD) are also acceptable.

Nig. J. Anim. Prod. 2010, 37(2):162 - 172

Comparative evaluation of anaerobically fermented/lyle treated and roasted *Delonix regia* seed meal as a replacement for groundnut cake in broiler diets

***S. S. A. Egena, S. K. Yahaya, E. L. Shiawoya, and A. Usman**
Department of Animal Production, Federal University of Technology, P.M.B. 65, Minna, Niger State, Nigeria.
Email: essa_may25@yahoo.com
**Corresponding Author*

Abstract

This experiment was carried out to evaluate the replacement value of anaerobically fermented/lyle treated and roasted Delonix regia seed meal in broiler diet. 180 day- old broiler chicks of the Hubbard breed were used for the experiment. The experimental period spanned 63 days. The birds were randomly allotted to six treatment groups designated as T_1, T_2, T_3, T_4, T_5 and T_6 respectively. Each treatment was replicated three times in a completely randomized design. The data collected were on feed intake, body weight, body weight gain and feed conversion ratio. The results obtained showed that mean body weight, mean body weight gain, mean feed intake and mean feed conversion ratio were not significantly affected ($P>0.05$) at the starter phase of the experiment although birds fed the Delonix regia seed meal based diets performed better than those fed the control diet except in feed utilization. Mean feed intake, mean body weight gain and mean feed conversion ratio were affected significantly ($P<0.05$) at the finisher phase of the experiment. Birds fed T_3 ingested more feed (946.00) followed by those fed T_5 (940.70), T_2 (920.80), T_6 (919.60), T_4 (907.10) and T_1 (740.10). Birds fed T_2 had better body weight gain (308.55) followed by those fed T_5 (308.03), T_3 (282.58), T_6 (267.95), T_4 (266.35) and T_1 (210.08) in that order. Utilization of feed during this phase of the experiment was better in birds fed the untreated diet (2.98), followed by those fed the treated diets (T_5 = 3.05, T_3 = 3.35, T_4 = 3.41, T_6 = 3.43) while those fed the control diet least utilized the feed (3.52). It was concluded that well treated, Delonix regia seed meal could be incorporated in broiler diet up to 7.5% without any deleterious effect on their performance.

Keywords: Anaerobic fermentation, Broiler, *Delonix regia*, Lyle treatment, Roasting.

Introduction

Despite the initial setback as a result of the outbreak of avian influenza disease, poultry production is on the increase again in Nigeria. This is great news as the sector possess the capacity to further contribute more of meat and egg for the ever increasing Nigerian population which has been estimated to be 123.3 million (PRB, 2002). To be able to do this, poultry birds must be provided with feed that are rich both in quantity and quality. This is a major constraint which needs be addressed as feeding alone is said to constitute about 60-70% of the total cost of livestock production in the country (Nworgu *et al.*, 1999; Akinfala and Tewe, 2001) compared to 50-60% in developed countries (Tackie and Flensher, 1995). With the high cost of feeding, poultry farmers are forced to use less qualitative feeds which in turn lead to reduced performance.

Several workers have proposed the use of little known non-conventional products as feed ingredients (Madubuike and Ogbonnaya, 2003; Okereke *et al.*, 2006). These ingredients have the effect of reducing the cost of feeding since most of them can be obtained at little or no cost and are quite rich in nutrients. Examples of such ingredients include: *Acacia sieberiana* (Mustapha and Oguntona, 1990), locust bean (Ahmed and Olorede, 2003) and *Afzelia africana* (Ayanwale *et al.*, 2007).

Delonix regia seeds are obtained from a deciduous leguminous plant naturally adapted to most parts of Nigeria (Yusuf *et al.*, 2004). The tree is commonly called Flame of the forest because of its beautiful reddish yellow flowers. The tree also provides shade. The seeds are hardy. Like all legumes, there is the need to treat *Delonix regia* seed before usage so as to reduce or eliminate anti-nutritional factors inherent in them. According to Oduguwa *et al.* (1999) and Oboh and Ekperigin (2003), these anti-nutrients include trypsin inhibitor, tannin, oxalate, alkaloid, phytase, cyanide and lectin. These anti-nutrients affect poultry birds in various ways, which include: growth depression, starch and protein digestibility, mineral availability and respiration (Liener, 1989).

Yusuf *et al.* (2004) used toasted *Delonix regia* seed meal as a replacement for soyabean in broiler diet and reported no significant effect on feed conversion ratio and final body weight of the birds. Daily gain, however, showed a significant decrease with increase in the usage of the seed meal.

There is the need to engage in further research into other means of processing the seed into meal in order to ensure its full acceptance and exploitation as a veritable alternative to the conventional and costly sources of protein such as groundnut cake, fish meal and soyabean meal.

In this study, an evaluation of anaerobic fermentation/lyle treatment as a means of processing was undertaken and its effect on broiler performance was compared with the effect of roasting the seeds before feeding.

Materials and Methods

Location

The experiment was carried out in the poultry unit of the Department of Animal Production, School of Agriculture and Agricultural Technology of the Federal University of Technology, Minna, Niger State, Nigeria. Minna lies within the northern guinea savanna

vegetation area of the country with an annual rainfall regime of about 1100-1600mm. It has two distinct seasons; six months of rainfall, followed by a dry spell of another six months.

Feed ingredients and experimental diets

The feed ingredients used for the trial were all sourced from Minna. *Delonix regia* seeds were collected from within the town where the tree is planted as a source of shade and for ornamental purpose. The seeds collected were divided into three parts. One part was left untreated but milled and stored as untreated *Delonix regia* seed meal (UDRSM). The second portion was milled using a hammer mill and anaerobically fermented using the method described by Annongu *et al.* (2004). It involved milling the seeds using a hammer mill with sieve size of 3mm. The milled seeds were then soaked in a given quantity of tap water for 7 days after which the dough was removed and packed in double layered polythene bags and tied to exclude air. It was then placed in a drum, covered to make it air-tight, and left to ferment for another 7 days. After this, the dough was soaked in lyle solution (constituted by dissolving 20Kg of ash in 100Litres of water) for 2 days. It was then strained, sun-dried and stored until further use as anaerobically fermented and lyle treated *Delonix* seed meal (AFLTDSM). The third portion was roasted in a pan placed over an open flame for up to 15 minutes. The content was stirred repeatedly to prevent charring. The seeds were considered roasted when about 75-80% of them cracked. The seeds were then spread out to cool after which they were milled and stored ready to use as roasted *Delonix regia* seed meal (RDRSM). These were used in formulating six diets designated as: T_1 (control), T_2 (5% UDRSM), T_3 (5% AFLTDRSM), T_4 (5% RDRSM), T_5 (7.5% AFLTDRSM) and T_6 (7.5% RDRSM) respectively (Table 1).

Experimental birds and their management

One hundred and eighty day-old broiler chicks of the Hubbard breed were used for the experiment. That means 30 birds/treatment and 10 birds/replicate. The necessary sanitary precautions were observed. Wood shavings were used as bedding material and the house was electrically heated using 100 watts bulbs. The chicks were weighed on arrival in groups and randomly allotted to the six treatment groups of three replicates in a completely randomized design. Feed and water were given *ad libitum.* All necessary preventive medications and vaccinations against endemic diseases were provided and administered at the appropriate time schedule.

Chemical analysis

The test material (*Delonix regia* seed) was analyzed for tannin, cyanide and trypsin inhibitor activity (TIA) using a modification of the method of AOAC (1984) while phytate was determined by the method of Latta and Eskin (1980). The chemical composition of the experimental diets was analyzed by the method of AOAC (1990).

Parameters measured

The parameters measured included: mean body weight, body weight gain and feed intake while feed conversion ratio was calculated.

Table 1a: Percent Composition of Experimental diets fed to broilers during the Starter phase

Ingredient	T_1	T_2	T_3	T_4	T_5	T_6
Maize	54.30	54.30	54.30	54.30	54.30	54.30
GNC	32.90	27.90	27.90	27.90	25.40	25.40
Maize bran	4.45	2.45	2.45	2.45	2.45	2.45
DSM	0.00	5.00	5.00	5.00	7.50	7.50
Fish meal	3.00	5.00	5.00	5.00	5.00	5.00
$CaCO_3$	1.00	1.00	1.00	1.00	1.00	1.00
Bone meal	0.80	0.80	0.80	0.80	0.80	0.80
Palm oil	3.00	3.00	3.00	3.00	3.00	3.00
Salt	0.10	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10	0.10
*Premix	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
% CP	22.00	22.00	22.00	22.00	22.00	22.00
ME (Kcal/Kg)	3138	3049	3047	3052	3014	3029

*2.5Kg of premix supplied: Vitamin A (10000000 IU), Vitamin D_3 (2000000 IU), Vitamin E (12000 IU), Vitamin K (2 IU), Thiamine B (1.5g), Riboflavin B_2 (5g), Pyriboflavin B_6 (1.5g), Vitamin B_{12} (10mg), Biotin (20mg), Niacin (15g), Pantothenic acid (5g), Folic acid (0.6g), Manganese (75g), Zinc (50g), Iron (25g), Copper, Iodine (1g), Selenium (100mg), Cobalt (300mg), BHT (125g), Cholinechloride (150g).
T_1 (control), T_2 (5% UDRSM), T_3 (5% AFLTDRSM), T_4 (5% RDRSM), T_5 (7.5% AFLTDRSM) and T_6 (7.5% RDRSM).
DSM = *Delonix* seed meal.

Statistical analysis

All data obtained were subjected to analysis of variance using MINITAB version 14 (2004) and treatment means separated using (Duncan, 1955) where there were significant differences ($P<0.05$).

Results

Table 2 showed the effect of anaerobic fermentation/lyle treatment and roasting on the anti-nutritional factors inherent in *Delonix regia* seed meal. It showed that phytic acid was greatly reduced by subjecting the seeds to anaerobic fermentation followed by lyle treated (52.59%) when compared to roasting (6.77%). Roasting however led to a greater reduction in cyanide (41.89%) and TIA (61.76%) compared to anaerobic fermentation/lyle treatment (18.37%) and (47.30%) respectively. Both treatments led to increase in tannin content of the seed meal; 24.16% (AFLTDRSM) and 3.54% (RDRSM).

Table 3 showed the proximate composition of the untreated *Delonix regia* seed meal as well as that of the anaerobically fermented/lyle treatment and roasted *Delonix regia* seed meals. It showed that RDRSM contained high dry matter (89.40%), crude protein (18.90%), ether extract (9.00%) and Nitrogen free extract (47.10%). Its ash content was however lower (3.40%) than that of the AFLTDRSM and the untreated seed meal

Table 1b: Percent Composition of Experimental diets fed to broilers during the Finisher phase

Ingredient	T_1	T_2	T_3	T_4	T_5	T_6
Maize	56.80	56.80	56.80	56.80	56.80	56.80
GNC	26.70	21.70	21.70	21.70	19.20	19.20
Maize bran	6.00	5.00	5.00	5.00	5.00	5.00
DSM	0.00	5.00	5.00	5.00	7.50	7.50
Fish meal	4.00	5.00	5.00	5.00	5.00	5.00
$CaCO_3$	1.00	1.00	1.00	1.00	1.00	1.00
Bone meal	0.80	0.80	0.80	0.80	0.80	0.80
Palm oil	4.00	4.00	4.00	4.00	4.00	4.00
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10	0.10
*Premix	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
% CP	20.00	20.00	20.00	20.00	20.00	20.00
ME (Kcal/Kg)	3240	3132	3129	3134	3003	3007

*2.5Kg of premix supplied: Vitamin A (10000000 IU), Vitamin D_3 (2000000 IU), Vitamin E (12000 IU), Vitamin K (2 IU), Thiamine B (1.5g), Riboflavin B_2 (5g), Pyriboflavin B_6 (1.5g), Vitamin B_{12} (10mg), Biotin (20mg), Niacin (15g), Pantothenic acid (5g), Folic acid (0.6g), Manganese (75g), Zinc (50g), Iron (25g), Copper, Iodine (1g), Selenium (100mg), Cobalt (300mg), BHT (125g), Choline chloride (150g).
T_1 (control), T_2 (5% UDRSM), T_3 (5% AFLTDRSM), T_4 (5% RDRSM), T_5 (7.5% AFLTDRSM) and T_6 (7.5% RDRSM).
DSM = *Delonix* seed meal.

Table 2: Effect of anaerobic fermentation/lyle treatment and roasting on anti-nutritional factors in *Delonix regia* seed meal

Parameters	DRSM	AFLTDRSM	RDRSM
Phytate (mg/100g)	503.10	238.50	469.04
% of phytate removed	----	52.59	6.77
Tannin (g/Kg)	22.64	28.11	23.44
% increase in tannin	----	24.16	3.54
Cyanide (mg/100g)	18.07	14.75	10.50
% of cyanide removed	----	18.37	41.89
TIA (mg/g)	36.85	19.42	14.09
% reduction in TIA	----	47.30	61.76

Table 3: Proximate composition of untreated, anaerobically fermented/lyle treated and roasted *Delonix regia* seed meal

Fraction (%)	UDRSM	AFLTDRSM	RDRSM
DM	81.80	87.10	89.40
CP	18.10	18.10	18.90
CF	7.50	11.00	11.00
EE	7.50	7.50	9.00
Ash	3.60	3.60	3.40
NFE	45.10	46.90	47.10

Table 4: Proximate composition of the experimental diets

Fraction (%)	T_1	T_2	T_3	T_4	T_5	T_6
Starter phase						
DM	77.20	80.00	81.00	85.80	85.80	85.20
CP	23.00	22.80	22.75	23.80	22.75	23.00
CF	3.30	4.60	3.61	4.10	5.60	4.30
EE	20.00	17.50	17.00	18.60	19.00	19.00
Ash	5.40	4.80	5.40	4.20	4.80	5.20
NFE	36.30	30.30	31.74	35.10	33.65	33.70
Finisher phase						
DM	81.30	82.40	85.70	86.70	85.20	86.70
CP	19.60	19.30	19.90	20.70	19.70	19.60
CF	5.50	5.00	4.00	3.00	6.00	3.00
EE	19.60	18.30	22.00	20.00	21.35	18.80
Ash	4.40	4.90	6.40	5.00	4.92	5.90
NFE	32.20	34.90	33.40	38.00	33.23	39.40

T1 (control), T2 (5% UDRSM), T3 (5% AFLTDRSM), T4 (5% RDRSM), T5 (7.5% AFLTDRSM) and T6 (7.5% RDRSM).

(3.60). The crude fibre content was similar to that of AFLTDRSM (11.00%) and higher than that of the untreated sample.

Table 4 represented the proximate composition of the experimental diets used in feeding the birds at both phases of the experiment. At the starter phase, treatments 4 and 5 had the highest dry matter (85.80%) while treatment 4 had the best crude protein (23.80%). Treatment 5 also had higher crude fibre content (5.60%). The control diet was higher in NFE content (36.30%) compared to the other diets. At the finisher phase, treatment 6 had higher content of NFE (39.40%) followed by treatment 4 (38.00%). Treatment 3 contains more ether extract (22.00%) and ash (6.40%).

The highest feed intake, body weight and body weight gain were recorded by birds fed the AFLTDRSM and RDRSM based diets (Table 5) compared to those fed the control diet at the starter phase, although no significant differences were observed between the mean values ($P>0.05$). The trend was similar at the finisher phase. However, while the final body weights were not significantly affected ($P>0.05$), mean final feed intake and final body weight gain were significantly ($P<0.05$) increased in birds fed *Delonix regia* seed meal based diets. Feed conversion ratio was better ($P>0.05$) in the control diet compared to the treated diets at the starter phase of the experiment. At the finisher phase however, birds fed the treated diets had

Table 5: Performance of broilers fed roasted and anaerobically fermented/lyle treated *Delonix regia* seed meal based diets

Parameter	T_1	T_2	T_3	T_4	T_5	T_6	St_{DEV}
Starter phase							
Initial weight (g/bird)	60.30	61.00	61.20	60.00	60.00	60.50	
Final body weight (g/bird)	279.20	325.70	312.90	338.80	300.10	334.70	185.80ns
Feed intake (g/bird)	285.20	387.00	381.50	411.40	394.10	393.10	153.70ns
Weight gain (g/week)	103.80	118.78	109.20	127.70	110.31	106.75	30.24ns
FCR	2.75	3.26	3.49	3.22	3.57	3.68	0.31ns
Finisher phase							
Initial weight (g/bird)	312.86	326.50	310.10	336.78	312.80	334.68	
Final body weight (g/bird)	1506.90	1543.00	1545.50	1546.10	1595.70	1583.60	421.20ns
Feed intake (g/bird)	740.10^{a}	920.80^{b}	946.00^{c}	907.10^{b}	940.70^{c}	919.60^{b}	152.80*
Weight gain (g/week)	210.08^{a}	308.55^{d}	282.58^{c}	266.35^{b}	308.03^{d}	267.95^{c}	58.96*
FCR	3.52^{d}	2.98^{a}	3.35^{c}	3.41^{bc}	3.05^{b}	3.43^{bc}	0.20*

ns: not significant ($p>0.05$)

^{a,b,c} means in the same row with different superscripts are significantly different ($P<0.05$)

St_{DEV}: standard deviation

T_1 (control)
T_2 (5% UDRSM)
T_3 (5% AFLTDRSM)
T_4 (5% RDRSM)
T_5 (7.5%AFLTDRSM)
T_6(7.5%RDRSM).

significantly better ($p<0.05$) feed conversion ratio compared to the control diet but poorer values when compared to birds fed the untreated diet.

Discussion

The reduction observed in phytate due to roasting is not very appreciable and this may have to do with the fact that phytates are stable to heat treatment (Kaankuka *et al.*, 1996). The tannin content of the seed meal was elevated as a result of roasting and anaerobic fermentation/lyle treatment. This may be due to the fact that fermentation and roasting removed moisture from the seed meals thereby making the tannins to become more concentrated in the seed meal hence, the higher values observed. Roasting also appeared to be more superior to anaerobic fermentation/lyle treatment as a means of reducing cyanide and trypsin inhibitor activity in *Delonix regia* seed meal. This makes the seed meal more useable since a reduction in hydrogen cyanide and trypsin inhibitor activity will ensure that feeds compounded using them will be well digested and absorbed.

Roasting the seeds seemed to have concentrated the nitrogenous compounds by the reduction of the moisture content of the seed thereby increasing the dry matter, crude protein and ether extract. The NFE content of the treated seed meal was also elevated compared to the UDRSM. The lower NFE value in AFLTDRSM compared to that in RDRSM might be due to leaching out of the carbohydrate component of the seed meal. The fermentation process also, might have used up most of the sugars in the seed tissue converting them to alcohol and water.

The proximate composition of the experimental diets showed that all the diets are quite rich in protein content and their values fall within the range advocated for broilers in the tropics (Oluyemi and Roberts, 2000). The crude fibre content of 3.00 to 6.00 also falls within the range tolerated by starter broilers (Njike and Ndife, 1980) and much lower than levels tolerated by adult birds. As such, the fibre couldn't have seriously impaired feed intake and nutrient usage, especially as the birds' increased in age.

The productive performance results observed in this trial agrees with the findings of Yusuf *et al.* (2004). Although no significant effect was observed in feed intake, birds fed *Delonix regia* based meals ingested more feed than those fed the control diet. This is evidence that the test material, either in its raw form or in the treated form is acceptable to the birds.

Equally, birds fed roasted *Delonix regia* seed meal based diets ingested more feed than their peers fed the fermented meals. This might indicate that roasting render the meal to be more palatable and digestible than the anaerobically fermented/lyle treated meal. Beside, the lower content of phytate, cyanide and trypsin inhibitor activity might have played a key role in this regard. Roasting has the effect of breaking complexes that might have been formed between enzymes, tannin, trypsin inhibitor and cyanide, thereby enhancing the action of gastrointestinal digestive enzymes.

At the finisher phase, feed intake, body weight gain and feed conversion ratio of birds fed *Delonix regia* seed meal based diets were all significantly better compared to the birds fed the

control diet. Both treatments (anaerobic fermentation/lyle and roasting) gave an increase in feed intake and weight gain in the finisher birds with the effect that better final body weights were observed for birds fed these diets. Bogart and Taylor (1983) reported that growth is a function of feed consumption and that weight gain is positively related to feed consumed above that needed for maintenance purposes. The better feed conversion ratio observed in birds fed *Delonix regia* seed meal based diets is indicative of better nutrient utilization. This might have led to better body weight gain with its attendant effect on final body weight. Feed conversion ratio is a measure of the extent of diet utilization (Maynard *et al.*, 1979). The final body weights obtained in this study, however is lower than that reported by Yusuf *et al.* (2004). This might be due to bird factor and the possible build up of absorbed anti-nutrients due to prolonged exposure to the residual anti-nutritional factors in the *Delonix regia* seed meals. Some deleterious effects might have been impacted on the body metabolism of the birds (Gumbmann *et al.*, 1985; Grant, 1989), which affected growth.

Conclusion

The findings from this study indicated that *Delonix regia* seed meal can be fed to broilers either in its raw untreated form or after treatment (fermenting/lyle treatment and roasting) without any negative effect. Its exploitation should therefore be rigorously pursued as an alternative to the more costly conventional protein sources. However to overcome the effect of residual anti-nutritional factors especially as the birds matures, it would be wise if the seed is first treated.

References

Ahmed, T.S. and Olorede, B.R. (2003). Effect of feeding varying level of locust beans (*Dorowa*) on the carcass yield and economy of broiler production. In: *Proceedings of the 8th Annual Conference of Animal Science Association of Nigeria*. Minna, Niger state, Nigeria. 15th-18th September. Pp: 4-6.

Akinfala, E.O. and Tewe, O.O. (2001). Utilization of whole cassava plant in the diets of growing pigs in the tropics. *Livestock Research for Rural Development*. http://www.cipav.org.co/lrrd/lrrd13/5/akin135.htm

AOAC (1984). Official methods of analysis of the Association of Official Analytical Chemists. 14th edition. Washington DC.

AOAC (1990). Official methods of analysis of the Association of Official Analytical Chemists. 15th edition. Washington DC.

Annongu, A.A., Joseph J.K. and Liebert, F. (2004). Effect of anaerobic fermentation and lyle treated *Prosopis africana* seed meal on the nutritional and haematological responses of Harco chicks. *Journal of Raw Material Research 1(1)*: 33-41.

Ayanwale, B.A., Obun C.O. and Ayanwale, A.V. (2007). Effect of raw and roasted wild *Afzelia africana* seed meal based

diets on broiler chicken. *International Journal of Poultry Science 6(1)*:27-30

Bogart, R. and Taylor, R.E. (1983). *Scientific farm animal production*. 2nd edition. McMillan publishing coy. New York, USA.

Duncan, D.B. (1955). Multiple range and multiple F-test. *Biometric 11*: 1-42.

Grant, G. (1989). Anti-nutritional effects of soyabean: A review. *Progress Food Nutrition Science 13*:317-348.

Gumbmann, M.R., Spangler, W.L., Dugan, G.M., Rackis, J.J. and Liener, I.E. (1985). The USDA trypsin inhibitor study. IV. The chronic effects of soy flour and soy protein isolate on the pancreas in rats after 2 years. Quality Plants. *Plant Food Human Nutrition 35*:275-314

Kaankuka, F.G., Balogun, T.F. and Tegbe, T.S.B. (1995). Effects of duration of cooking of full-fat soyabeans on proximate analysis, level of anti-nutritional factors and digestibility by weaning pigs. *Animal Feed Science Technology 62*:229-237.

Latta, M. and Eskin, M. (1980). Simple colorimetric method of phytate determination. *Journal of Agriculture and Food Chemistry 28*: 1313-1315.

Liener, I.E. (1989). Antinutritional factors in legume seeds: state of the art. In: *Recent advances of research in Antinutritional factors in legume seed*. Huisman, J., Van der Poel, T.F.B. and Liener, I.E. (eds). Pudoc, Wageningen. The Netherlands. 6-13pp.

Madubuike, F.N. and Ogbonnaya, O. (2003). The potential use of white star apple seeds (*Chrysophllum albidum*) and physic nut (*Jatropha curcas*) as food ingredient for rats. *Journal of Agriculture and Food Science 1(2)*:97-105.

Maynard, L.A., Loosli, H.F. and Warner, R.G. (1979). *Animal Nutrition*. 7th edition. Tarta McGraw Hill Publishing. New Delhi. 348pp.

MINITAB (2004). Minitab for windows version 14. Statistical package.

Mustapha, G.G. and Oguntona, T. (1990). Performance of broilers given different levels of *Acacia siberiana* seeds. *Nigerian Journal of Animal Production 17*:11.

Nworgu, F.C., Adebowale, E.A., Oredein, O.A. and Oni, A. (1999). Prospect and economics of broiler production using two plant protein sources. *Tropical Journal of Animal Science 2(1)*:159-166.

Njike, M.C. and Ndife, L.I. (1980). Protein and energy requirements of broiler chickens in the tropics. *Nigerian Journal of Animal Production* 7:97-105.

Oboh, G. and Ekperigin, M.M. (2003). Nutritional evaluation of some Nigerian wild seeds. *Journal of Food and Human Nutrition.* 7: 204-214.

Oduguwa, B.O., Oduguwa, O.O. and Amore, E.A. (1999). Effect of season on the anti-nutritional factors in some foliages of some leguminous trees. In: *Proceedings of the 26th Annual Conference of the Nigerian Society of Animal Production.* Ilorin. Pp: 10-12.

Oluyemi, J.A. and Roberts, F.A. (2000). *Poultry production in warm wet climates*. 2nd edition. Avi publ. Westport Connecticut, USA.

Okereke, C.O., Ukachukwu, S.N. and Nsa, E.E. (2006). Potentials of cassava leaves and/or foliage in poultry. In: *Proceedings of the 40th Annual Conference of the Agricultural Society of Nigeria.* Abia state, Nigeria. 16th-20th October. Pp:515-517.

PRB (2000). Population Reference Bureau, Call Hauba and Diana Cornelius. Design and production. Heather lilly, PRB, Washington DC.

Tackie, A.M. and Flenscher, J.E. (1995). Nutritional value of wild sorghum fortified with *Leucaenia leucocephala* (Wh. Lam). *Bulletin Animal Africa* 47:223-275.

Yusuf, N.D., Mohammed, M.M., Aya, V.E., Mazawaje, D.A., Hassan, D.I. and Abdullahi, U.S. (2004). Evaluation of toasted flamboyant (*Delonix*) seed meal as replacement for Soyabean meal in broilers diet. In: *Proceedings of the 38th Annual Conference of the Agricultural Society of Nigeria*. 17th-21st October. Pp:649-652.

(Received 20th Dec. 2008; Accepted 22nd Jan. 2010).