Nigerian J. Anim. Sci. 2021, 23 (2): 222-231

Effects of graded levels of *Vernonia amygdalina* (Bitter) leaf meal based diets on performance of broilers chickens

***Akorede, A.A., Bolu, S.A, Sola-Ojo, F.E and Yusuf, O. A.**

Department of Animal Production, University of Ilorin, Ilorin, Kwara State

****Corresponding Author:** aakorede@polarisbanklimited.com;* ***Phone Number:** +234-8033734455.*

***Target Audience:** Poultry farmers, Researchers, Feed miller, Animal Nutritionist*

Abstract

Feed accounts for over 70% of the total cost of producing broiler chicken meat and the quality of livestock feeds are implicated in mortality, reduced performance and profitability. The importance cannot be over-looked, thus researchers must keep working to produce feed that will be affordable and easily be at farmers' reach. This study used a total of two hundred and twenty-five (225) three weeks old Marshall broiler chickens to investigate the effect of feeding graded levels of Vernonia Amygdalina leaf meal (VALM) on broiler chickens in Completely Randomised Design at the rate of 0, 5, 10, 15 and 20%. The results showed that feed intake, weight gain and final weights are inversely proportional to inclusion of VALM and were significantly (P<0.05) different across the dietary treatments. Similar (P>0.05) values were obtained for Feed Conversion Ratio (FCR) of broiler chickens fed 0 and 5% VALM as well as those fed 10 and 15% VALM, while those fed 20% VALM had poor and highest FCR. Cost of feed consumed per bird reduced as the inclusion level of VALM increased in the experimental diets, while cost per kilogram of weight gain and net benefit of production were higher in broiler chickens fed the control diet followed by those fed 5 % and lowest in those fed 20% VALM, which shows that the cost per kilogram, in birds not fed VALM are similar to those fed 5% VALM. This study showed that the cost benefit ratio was similar in broiler chickens fed the control diet and those fed 5% VALM and therefore recommend 5% inclusion of VALM in broiler chickens diet.

***Key Words**: Broilers Chickens, Cost-Benefit, Feed, Performance Vernonia Amygdalina.*

Description of the Problem

The relevance of protein in human and animal nutrition cannot be over emphasized. In recent times, there has been a significant short fall between the production and supply of animal protein to feed the ever increasing population (1). Nigeria is highly deficient in animal protein security with the per capita consumption put at 9.3g/day as against the 34g/day recommended by the FAO to be the minimum requirement for the growth and development of the body (1, 2 and 3). This implies that only about 27.35 percent of the minimum requirement in animal protein intake is secured. Therefore, one serious challenge facing Nigeria today is the attainment of substantial increase in the domestic animal supply to bridge the deficiency in animal protein availability in the menu of the citizens. The major problem of development and expansion of livestock industries in developing Countries are the reduced supply, high demand and prohibitive cost of feeds and feed stuffs, especially, protein source (4). The ever-increasing cost of livestock feeds with the attendant increase in the cost of animal products such as meat, eggs, milk shows that there is the need to explore the use of non-conventional feed ingredients in the feeding of domesticated animals (5). The non-conventional feed ingredient being considered in this study is bitter leaf (*Vernonia amygdalina*). *Vernonia amygdalina* is cultivated in Nigeria mainly for its nutritional value (6). Various authors have reported various values of crude protein for *Vernonia amygdalina* leaf meal (VALM). (7) reported 15.67% while (8, 9, 10 and 5) reported Crude protein (CP) range of 18 - 21.50%. However a high value of 32.60% from *Vernonia amygdalina* extracts was reported by (11). Having established *Vernonia amygdalina* leaf meal as an alternative feed source, the importance of poultry in bridging protein gap can also not be over emphasized. Poultry is important for the provision of egg and meat. The previous study dealt with the performance of laying hens fed graded levels of sun-dried VALM, this study would examine the response of broiler chickens to graded levels of VALM.

The objective of this study was to determine the effect of graded levels of *Vernonia amygdalina* leaf meal supplementation on the performance with regards to average weight gain, average daily feed intake, FCR, production cost and net benefit of producing broiler chickens.

Materials and Methods

Collection of *Vernonia amygdalina* leaves

Fresh *Vernonia amygdalina* leaves were collected from Amoyo Village of Ilorin South Local Government Area, Kwara State, Nigeria between May and June 2016. The area falls within the latitudes 8.4158446 North and longitudes 4.6202556 East. The leaf was sun-dried, crushed, milled and mixed with the other feed ingredients in the broiler finishers' diet.

Table 1: Composition of experimental diets

Ingredients	Control 0%	(I) 5%	(II) 10%	(III) 15%	(IV) 20%
Maize	55	55	55	55	55
Soybean	23	23	23	23	23
Groundnut Cake	6	6	6	6	6
Maize Offal	7	7	7	7	7
Fish meal (72%)	5	5	5	5	5
Dicalcium Phosphate (DCP)	2	2	2	2	2
Oyster Shell	1	1	1	1	1
Vitamin/Mineral Premix*	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	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 (%)					
Minus (-) Basal Diet	**0**	**(-)5%**	**(-)10%**	**(-)15%**	**(-)20%**
Plus (+) VALM	**0**	**5%**	**10%**	**15%**	**20%**

Experimental diets and management of birds

Five (5) experimental diets were formulated with the inclusion of *Vernonia amygdalina* Leaf Meal (VALM) at 0, 5, 10, 15 and 20% of the total ration (Table 1.0). A total of two hundred and twenty five (225), three weeks old broiler chicken of the Marshall Strain were used for this study, the birds were obtained at day old and were allowed to acclimatize within the first three weeks of life by feeding them commercial diets recommended for young broiler chickens. The average initial weight of the broiler was 626 $\pm$1.31g. The experimental birds were randomized into five (5) treatment groups. Each treatment was replicated five (5) times with nine birds per replicate. Birds were housed in electrically heated metabolic battery cages. The birds were fed the various levels of sun-dried VALM supplementation at 0, 5, 10, 15 and 20% which were incorporated into the basal diet formulated to meet the nutrient requirement (12) for broilers (Tables 1.0).

Routine management and vaccinations were followed. Feed and water were given *ad libitum* for the 35 days feeding trial. Feed intake and weight gain were recorded weekly and used to determine the feed to gain ratio. Broilers in all groups were given weighted quantity of feed daily in a double meal at 08:00 hours and 15:00 hours (morning and late afternoon). The left-over were collected and weighed daily to determine the daily feed consumption. The birds were weighed individually at the beginning of the experiment and thereafter, weekly.

Chemical analysis of experimental diets

Chemical analyses were carried out on the feed samples to determine the proximate composition. Moisture content, Crude Protein, Crude Fat, Crude Fiber and Total Ash using the methods described by (13) and (14).

Data collection

Changes in body weights were noted and recorded for five weeks. Records taken include daily feed intake, weekly body weight changes and mortality. At the end of the experimental period, these records were used to evaluate economic indices such as cost / kg feed, cost of total feed consumed per bird, cost / kg weight gain, revenue from sales, net benefit, cost-benefit ratio and cost of feed per bird in relation to total variable costs. Average daily feed intake (ADFI), Feed Conversion ratio (FCR) and cost Benefit Ratio were calculated according to (15).

Statistical analysis

The data collected were subjected to one-way Analysis Of Variance (ANOVA), using SPSS version 21 (16). All data is expressed as Mean ± SE (Mean of 3 determinations) and difference between groups considered significant at $p < 0.05$. Where significant differences were observed, means were further subjected to New Duncan's New Multiple Range Test.

Results

Experimental diets

The milled sun-dried *Vernonia amygdalina* leaf was used to compound the experimental diets. The crude protein values of the experimental diets ranged from 19.93% to 21.8% depending on the level of *Vernonia amygdalina* Leaf Meal (VALM) included. The highest (21.80%) crude protein (CP) was recorded for the Control (0) while the lowest CP was recorded for the treatment diet containing 20% VALM. There appears to be no significant difference ($P< 0.05$) in the Crude Protein content of the Control Diet (0) and diet containing 5% VALM. The crude protein (CP) content decreased with the increased level of inclusion of VALM across the experimental diets. There was however no significant difference ($P<0.05$) in the Metabolizable Energy content of all the experimental diets regardless of the level of inclusion of the VALM except in treatment of diet IV as shown in Table 2.0.

Table 2: Proximatecomposition of the experimental diets

Parameters	Control 0%	(I) 5%	(II) 10%	(III) 15%	(IV) 20%	S.E.M	Sig
Crude Protein (%)	21.80[a]	21.44 [a]	20.72[b]	20.34[b]	19.93[b]	±1.23	S
Ash (%)	3.20[c]	3.40[c]	5.07[b]	10.53 [a]	11.37[a]	±2.73	S
Ether Extract (%)	7.13 [a]	6.30[b]	5.70[c]	5.17[c]	4.69[d]	±4.43	S
Crude Fibre (%)	4.54[c]	4.88[c]	5.22[b]	5.81[b]	6.65[a]	±3.42	S
Dry Matter (%)	91.55[c]	92.10 [a]	91.74[b]	91.96[b]	91.59[c]	±1.53	N
Metabolizable Energy(ME) Kcal/Kg	3285.07[a]	3243.84[a]	3237.99[a]	3224.78[a]	3133.55[b]	±1.63	S
Gross Energy (GE) Kcal/g	4.09[b]	4.69[a]	3.91[c]	4.56 [a]	3.47[c]	±3.14	

[abcde] Means in the same row for each parameter with different superscripts are significantly different ($p<0.05$).

Table 3. Productive performance offinisher broilers fed graded levels of *Vernonia amygdalina* leaf meal

Parameters	0%(Control)	5%	10%	15%	20%	S.E.M
Mean Initial Weight(g) @ 3weeks	628.5	626.5	626.5	627	626.5	±0.39
Ave. Final Weight (kg) @ 8weeks	2.41[a]	2.15[a]	1.88[b]	1.64[c]	1.52[c]	±0.16
Mean Weight Gain (kg)	1.78[a]	1.53[b]	1.25[c]	1.01[c]	0.89[d]	±0.16
Ave. Daily Wgt Gain (g)	42.31[a]	36.29[ab]	29.83[b]	23.98[c]	21.21[c]	±12.45
Total Feed Consumed (kg)	4.31a	4.28a	4.06[b]	3.98[c]	3.97[c]	±0.08
Ave. Daily Feed Intake (g)	123.2[a]	122.4[a]	116[b]	113.6[c]	113.5[c]	±2.12
FCR (feed:gain)	1.79[d]	1.99[d]	2.16[bc]	2.43b	2.61a	±0.15
Cost / Kg Feed (N)	128[a]	121.6[b]	115.2[bc]	108.8[d]	102.4[e]	±4.53
Cost of total feed consumed (N)	551.68[a]	520.45[a]	467.71[b]	433.02[b]	406.53[bc]	±26.87
Cost / Kg Wgt. Gain (N)	227.84[a]	186.05[ab]	144.00[c]	109.89[d]	91.14[de]	±24.95
Cost of Chick (N)	250	250	250	250	250	0
Operational Cost (N)	250	250	250	250	250	0
Revenue (@N600/kg LW)	1446[a]	1290[b]	1128[b]	984[c]	912c	±97.95
Production Cost (N)	1051.68[a]	1020.45[b]	967.71c	933.02[c]	906.53[d]	±26.87
Net Benefit (N)	394.32[a]	269.55[ab]	160.29[c]	50.98[d]	5.47e	±71.19
Cost : Benefit Ratio	0.27[a]	0.21[a]	0.14[b]	0.05[c]	0.01[d]	±0.05
Cost of Feeding (%)	52.46[a]	51.00[a]	48.33[b]	46.41[b]	44.85[c]	±1.41
Mortality (%)	0	0	0	0	0	0

[abcde] means in the same row for each parameter with different superscripts are significantly different ($P>0.05$).

Productive performance of broilers fed graded levels of VALM

The productive performances of the finisher broilers were observed in form of Average Daily Feed Intake (ADFI), Average Daily Weight Gain, Feed Conversion Ratio, cost / kg feed, cost of total feed consumed, cost / Kg weight gain, Net Benefit and Cost-Benefit Ratio. The results are presented in Table 3.0 and it shows that no mortality was recorded during the experiment across all the dietary treatment.

Initial body weight

The initial body weight of the experimental animals at three weeks ranged between 626.5 and 627±1.31g. There was no significant difference (P<0.05) in the initial body weight of the experimental birds across the treatment (Table 3.0)

Average daily feed intake (ADFI)

Table 3.0 also shows the average daily feed intake (ADFI) for birds fed the control diet (0%) was 123.2g/ bird/ day. Birds fed 20% *Vernonia amygdalina* leaf meal (VALM) had the lowest daily feed intake (113.5g). The average daily feed intake of the experimental birds decreased with increased level of inclusion of the VALM. Average Daily Feed Intake was 123.2g, 122.4g, 116g, 113.6g and 113.5g for broilers on Control, 5%, 10%, 15% and 20% VALM respectively. Feed intake was similar (P<0.05) for birds on control (0) and 5% VALM; also, there was no significant difference (P<0.05) in the average daily feed intake between birds fed 15% VALM and 20% VALM.

Average daily weight gain (ADWG)

The average daily weight gain was highest in the control diet (42.31g) and lowest (21.21g) in treatment diet containing 20% inclusion levels. Average Daily Weight Gain decreased (P<0.05) with increasing levels of inclusion of VALM. Average Daily Weight Gain was 42.31g, 36.29g, 29.83g, 23.98g and 21.21g for broilers fed Control, 5%, 10%, 15% and 20% VALM respectively. There were significant differences (P<0.05) in the ADWG between the treatment diets, however, it was similar for broilers on Control diet and those on 5% VALM inclusion level as shown in Table 3.0.

Average final weight (AFW)

The average final weight was highest in the control diet (2.41kg) and lowest in treatment diet containing 20% inclusion levels (1.52kg). Average Final Weight decreased (P<0.05) with increased levels of inclusion of VALM (Table 3.0). There was however no significant difference (P<0.05) in the AFW between Control diet and Treatment I (5%) and between birds fed 15% VALM and 20% VALM. Average Final Weight recorded for the broilers were 2.41kg, 2.15Kg, 1.88Kg, 1.64Kg and 1.52Kg for feed containing 0, 5%, 10%, 15% and 20% VALM respectively.

Feed conversion ratio (FCR)

There were significant differences (P<0.05) in the FCR across the diets. FCR was similar (P<0.05) for broilers on Control diet and treatment diet containing 5% VALM at 1.79 and 1.99 respectively while FCR was also similar for birds fed 10% VALM (2.16) and 15% VALM (2.43) as shown in Table 3.0. It was however highest for birds on 20% VALM inclusion levels (2.61). FCR increased with increased levels of inclusion of VALM in the treatment diets (Table 3.0).

Cost per kilogram of Feed

The cost per kilogram of feed was highest in the control diet (N128:00) and lowest in treatment diet containing 20% inclusion levels of VALM (N102:40). Cost per kilogram of feed decreased with increased levels of inclusion of VALM. There was however no significant difference (P<0.05) in the cost per kilogram of feed for broilers fed 5% VALM and 10% VALM as at the time of conducting this experiment and this is shown in Table 3.0.

Cost of total feed consumed

The total feed consumed was highest in the control with an average cost of N551.68 and lowest in treatment diet containing 20% inclusion levels of VALM (N406.53) as shown in Table 3.0. Cost of total feed consumed decreased with increased levels of inclusion of VALM. However, there was no significant difference (P<0.05) in the cost of total feed consumed by broilers in treatments diets containing 10%, 15% and 20% VALM.

Cost per kilogram weight gain

The cost per kilogram weight gain was significantly (P<0.05) higher for broilers on Control diet while it was lower for broilers fed 20% VALM were as shown in Table 3.0. Cost per kilogram weight gain decreased with increased level of inclusion of VALM in the experimental diets. There was however no significant difference (P<0.05) in the cost per kilogram weight gain between the Control and 5% VALM and between 15%VALM and 20% VALM.

Net benefit

The net benefit was significantly (P<0.05) higher for broilers on control diet and lowest for broilers fed 20% VALM. Net benefit decreased with increased levels of inclusion of VALM. Net Benefit was N394.32, N269.55, N160.29, N50.98 and N5.47 respectively for the birds on Control diet and birds on diets containing 5%, 10%, 15% and 20% VALM respectively (Table 3.0).Net benefit decreased (P<0.05) with increased levels of inclusion of VALM

Cost-Benefit ratio

The cost-benefit ratio (C-B) was similar (P<0.05) for birds on control diet and broilers on 5% VALM (Table 3.0). It was highest for broilers on control diet and lowest for those on 20% VALM. The C-B Ratios were 0.27, 0.21, 0.14, 0.05 and 0.01 for broilers fed Control, 5%, 10%, 15% and 20% VALM inclusion levels.

Discussion

Feed intake was observed to decrease with increasing levels of inclusion of *Vernonia amygdalina* Leaf Meal (VALM) in the experimental diets for the broilers. This result did not agree with the report obtained by (15) who administered bitter leaf extract infusion in broilers drinking water however; the feed intake trend was similar to the report of (17) for finisher broilers who obtained a decrease in feed intake with increasing levels of inclusion of bitter leaf meal. The decrease in feed intake of the broilers with increasing level of inclusion of bitter leaf meal may be due to the increasing concentration of antinutritional factors such as alkaloids and saponins (18). These suspected antinutritional factors may inhibit the utilization of certain essential nutrients and also depress feed intake of the birds.

Average daily weight gain and mean final weight also decreased with increasing levels of inclusion of bitter leaf meal. This result showed similar trend with the report of (19) who in a similar experiment with chicks and hen reported that 3% inclusion level of *Cassia obtusifolia* depressed feed intake of broiler chickens which consequently affected growth. The similar result for the birds on Control diet and birds on 5% VALM inclusion level may be due to the active components (alkaloids, saponins, tannins and glycosides) of VALM which were able to create a harmonious gut environment suitable for the release and assimilation of digestive nutrients necessary to enhance growth up to 5% inclusion level. At higher levels of VALM, the harmonious gut environment may have been distorted by nutrient imbalance and improper metabolism. This view agrees with the earlier views of (20) that at higher levels of *Leucaena leucocephala* leaf meal inclusion in diets of chicken above 5%, growth retardation occurred.

The lower the Feed Conversion Ratio (FCR) in this study, the higher the mean weight gained which means that the lower the FCR, the higher it was for the birds to convert feed consumed to meat. This result is in agreement with the findings of (21) who reported that inclusion of bitter leaf powder in cockerels feed significantly improved FCR.

The results also showed that the cost of feeding the birds decreased as the VALM inclusion increased, this result is similar to the finding of (15). The cost of feeding for the control group accounted for 52.46% while those for 5%, 10%, 15% and 20% VALM inclusion accounted for 51.0%, 48.33%, 46.41% and 44.85% respectively. Increase in the level of VALM inclusion in the experimental diets resulted in a significant (P<0.05) decrease in the cost per kg of feed. The cost (=N=) per kilogram of feed for birds on Control, 5% VALM, 10% VALM, 15% VALM and 20% VALM N128:00, N121.60, N115.20, N108.80 and N102.40 respectively. This was due to the lower cost of VALM compared to the cost of commercial feed estimated to be N2,300:00 for a 25kg bag as at the time of this study. The result of this experiment corroborates the findings of (22) who used pigeon pea seed meal as an unconventional feed ingredient to replace soybean in pullet's diet and obtained positive economic results.

Average final weight, Feed Conversion Ratio, Cost per kilogram weight gain, cost to benefit ratio and cost of feeding (%) were similar for both broilers on control (0) diet and broilers on treatment diet with 5% inclusion levels of VALM. These two feeding regimes yielded similar results. The results obtained from this study showed that the use of VALM as a feed supplement at 5% inclusion levels reduced costs while major economic indices were not compromised. This is in agreement with the findings of Owen *et al.* (2008), who used poultry litter as an unconventional feed ingredient and reported better performance in rabbits. However, (23) and (24) stressed that an essential practical consideration in evaluating a ration for farm animals is its cost in terms of returns obtained relative to its products. The cost of feeding (%) for this experiment ranged between 44.85% and 52.46%. This is similar to results (40.90% to 51.60%) obtained by (15) while it disagreed with the report of (25) who reported that feed accounts for 70 - 80% of the total variable cost of poultry production in Nigeria and other developing countries. High cost of feed has been largely traced to increasing costs of maize, soyabean and groundnut cake, which are the main conventional sources of energy and protein respectively (26; 27). The inclusion of VALM at 5%, 10%, 15% and 20% levels saved cost by 8.40%, 16.80%, 25.20% and 33.60% respectively. In other words, bitter leaf meal-based diet costs less than conventional concentrate feed presently available in the market as it is freely available to farmers. Since profit is a single index determining the economic value of keeping domestic birds (28, 29), the profitability index in this study varied among treatment diets, but it shows that it was more profitable to feed 5%, VALM (bitter leaf supplementation) than either of 10%, 15% and 20% inclusion levels.

Although, the level of profit in broiler production enterprise depends largely on other factors such as cost of chicks, level of test ingredients used, time of feeding trial, price of feed ingredients and the demand for broilers among others. Considering all these factors, profitability index may therefore vary from location to location, season to season as dictated by demand of consumers for broilers' meat.

Conclusion and Applications

1. Average daily feed intake and feed conversion ratio increased with

increasing levels of inclusion of VALM.
2. Broilers recorded linear decrease in average daily weight gain with increased level on inclusion of VALM.
3. Feed cost and cost of total feed consumed reduced with increased level of dieatry VALM
4. Net Benefit decreased with increased level of inclusion of VALM for broilers.
5. *Vernonia amygdalina* is a plant material with vast potential. Its composition suggests it will be of greater benefits in poultry if considered nutritional purposes, especially the sun-dried form.

References

1. Lamorde, A. G. (1997). Research priorities for sustainable women empowerment and development. A paper presented at the *National Conference on Research as Backbone for Sustainable Development* held in Abuja, 11th – 15th August, 1997.
2. Esobhawan A. O.; Ojo S. O. and Ikhelao, E. E. (2008). Profitability, input elasticity and returns to scale in agriculture production in Lagos State. *Proceeding of 14th Annual Conference of Agriculture in Nigeria.* Wetlands FUTA, Akure 21st May. Pp 219 – 222.
3. Esobhawan, A. O. (2007). Efficiency analysis of artisanal fishery production in Edo State. Unpublished Ph.D Thesis, Department of Agricultural Economics and Extension, Ambrose Alli University, Ekpoma.
4. Bamaiyi, P.H. (2013). Factors Militating Against Animal Production in Nigeria. *International Journal of Livestock Research*, Vol 3(2) May'13.
5. Owen, O.J, Alawa, J.P, Wekhe, S.N, Isirimah, N.O, Chukuigwe, E.C, Aniebo, A.O, Ngodigha, E.M and Amakiri, A.O. (2009). Incorporating poultry litter in rabbit feed. A solid waste management strategy. *Egyptian Journal of Animal Production*, 46 (1): 63-68.
6. Igile, G.O, Oleszek, W., Jurzysta, M., Aquino, R., de Tommasi, N and Pizza, C (1995). Vernoniosides D and E, two novel saponins from *Vernonia amygdalina*. *Journal of Natural Products*, 58: 1438-1443.
7. Durunna, C. S., Chiaka ,I. I., Udedibie, A. B. I., Ezeokeke, C. T. and Obikonu H. O. (2009). Value of bitter leaf (*Vernonia amygdalina*) leaf meal as feed ingredients in diet of finisher broiler chicken. *Proceedings International Conference on Global Food Crisis.* FUT Owerri, Nigeria, April 19-24th. pp 38 - 42.
8. Okoli, I. C., Ebere, C. S., Uchegbu, M. C., Udah, C. A. and Ibeawuchi, I. I. (2003). Survey of the diversity of plants utilized for small ruminant feeding in South Eastern Nigeria. *Agricultural Ecology and Environment*, 45 (6), 25 - 29.
9. Bonsi, M.L.K., Osuji, P.O., Tuah, A.K and Umunna, M.N. (1995). *Vernonia amygdalina* as supplement of teff straw (*Eragrostis tef*) fed to Ethiopian Menz sheep. *Agroforestry System*, 31: 229-244.
10. Fajemisin, A. N., Alokan, J. A., Onibi, G. E., Aro, S. O. and Fadiyimu, A. A. (2009). Response of West African dwarf ewes fed *Vernonia amygdalina* leaf meal in cassava starch residue - based diet. *Proceedings Nigeria Society for Animal Production (NSAP), 34th Annual Conference* March 15 - 18th, Uyo, Nigeria. pp 480 - 482.
11. Aletor, O., Oguntokun, M.O. and Aletor, V.A. (2002). Proximate composition, energy content and mineral profile of some conventional and underutilized fibrous feed resources. *Proceeding of 27th Annual Conference Nigerian*

Society for Animal Production (NSAP). Mar. 17-21. Fed. Uni. of Tech. Akure, Nig. Pp 135-138.

12. National Research Council NRC (1994). Nutrient requirement of livestock species (poultry, swine, sheep and goats, cattle, fish). National Academy of Science, Washington D.C.
13. AOAC. (1990). Official Methods of Analysis of the Association of Chemists. Analysis of the Association of Chemists, Washington, D.C. pp: 223-225, 992-995.
14. Kirk, B. and Sawyer, S. (1980). Pearson's Food Composition and Analysis. Longman Press, England, Pages: 34.
15. Owen, O. J., Amakiri, A. O. And Ezeano, C. I. (2010). The cost benefits analysis of incorporating bitter leaf (*Vernonia amygdalina*) meal in broiler finishers' diet. *Journal of Environmental Issues and Agriculture in Developing Countries*, Vol. 2 No. 1, April 2010. Pp 131-141
16. Statistical Package for Social Sciences (2013). SPSS Version 22 IBM Inc. 444 Michigan Avenue, Chicago, IL60611, USA.
17. Durunna, O N., Mujibi, F.D.N., L. Goonewardene, Okine, E.K., Basarab, J.A., Wang, Z and Moore, S.S. (2011). Feed efficiency differences and reranking in beef steers fed grower and finisher diets. *Journal of Animal Science,* 89:158-167
18. Esonu, B O, Opara, M N, Okoli, I C, Obikaonu, H O, Udedibe, C and Iheshiulor, O O M (2006). Physiological response of laying birds to neem (*Azadirachta indica*) leaf meal-based diets: body weight, organ characteristics and haematology. *Journal of Health and Allied Sciences,* 2:4.
19. Damron, B.L. and Jacob, J.P. (2002). Toxicity to poultry of common weed seeds. Florida cooperation Extension services, Institute of Food and Agricultural Sciences University of Florida.
20. D'Mello, J.P.E and Acamovic, T. (1989). *Leucaena leucocephala* in poultry nutrition. *Animal Feed Science and Technology*. 26: 1-28.
21. Olobatoke, R.Y. and Oloniruha, J.A. (2009). Haematological assessment of bitter leaf (*Vernonia amygdalina*) efficiency in reducing infections in cockerels. *Proceedings of the World Congress on Medicinal and Aromatic Plants*, November 9-14, 2008, Cape Town, South Africa, pp: 472-473.
22. Amaefule, K. U. and Obioha, F. C. (2005). Performance of pullets fed raw or processed pigeon pea (*Cajanus cajan)* seed meal diets. *Livestock Research for Rural Development.* http:// www.cipav.org.co./rrd17/03amae17033.htm
23. Maynard, L. A., Loosli, J.A., Hints, H. F. and Warner, H. S. (1979). Animal nutrition. (7th ed). Bombey: Taba Mcgraw-Hill, India.
24. Madubuike, F. N. and Obidimma, V. N. (2009). Brewers' dried grain as energy source on external and internal egg qualities of laying hens. *Proceedings of the 34th Annual Conference of the Nigerian Society of Animal Production,* 34:362-365
25. Owen O. J., Amakiri A. O., Ngodigha E. M. and Chukuigwe, E. C. (2008). The biologic and economic effect of introducing poultry waste in rabbit diets. *International Journal of Poultry Science,* 7 (11), 1036 -1038.
26. Onwudike, O. C. and T.A. Omole (1994). The use of maize cob in rabbit diets. *Proceedings 19th Annual Conference Nigeria Society for Animal Production (NSAP)* Benin, Nigeria pp 364 - 366.
27. Faniyi, G. F. (2002). Replacement of wheat offal with untreated citrus pulp in broiler chick diets. *Tropical Animal*

Production Invest, 5, 95- 100.

28. Olomu, J. M. (1995). Monogastric Animal nutrition: Principles and Practice. Benin City: A Jachen Publication, Nigeria.

29. Coelho, M. (1996). Optimum vitamin supplementation needed for Turkey performance and profitability. *Nutrition and Health/Poultry feedstuffs*. May 6th.