Economics of production and egg quality characteristics of Layer Chickens Fed Diets Containing *Prosopis Africana* Seed Coat Meal Treated with Polyzyme®

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***Abstract*— *The study evaluated the effect of prosopis africana seed coat meal (PASCM) on the economics of production and egg quality characteristics of three hundred (300) Nera brown layer chickens thatwere fed for 39 weeks. The birds were randomly allotted to 5 experimental diets with 3 replications of 20 birds each. The diets were formulated with the inclusion of PASCM at 0, 15, 20, 25 and 30% levels for treatments T_1, T_2, T_3, T_4 and T_5, respectively and the data collected were subjected to analysis of Variance in a completely randomized design. Results obtained showed that in the economics of egg production, egg/hen/day, egg sales/day (₦) and profit/day (₦) decreased with increased PASCM inclusion in the diets. While most of the egg quality parameters were affected ($P < 0.05$) by the dietary treatments, except egg weight, egg length, shell thickness and egg shape index. The economics of production and egg quality characteristics showed that 20% PASCM inclusion level resulted in optimum production and hence this level is recommended for adoption.*

Keywords*— *PASCM, Pullet Layer Chickens, economics of Production and egg quality characteristics.

I. INTRODUCTION

Inadequate supplies of feedstuffs at economic prices continue to limit the production of animal protein in Nigeria. This is because the cost of animal feed accounts for 60% and 70% of the cost of production in poultry enterprises in Nigeria. Nutritionists and other professionals therefore, strive to reduce this cost to maximize profit (Aletor, 2005; *Odeh et al.,* 2012).

This high cost of feed ingredients has scared some farmers from poultry business (Musa and Olarinde, 2008). The conventional feed like maize continues to be expensive. Maize constitutes the main component of energy diet in poultry production in Nigeria, suggesting that any increase in the price of maize may increase the price of animal products. Therefore, there is the need to find an alternative feed resource which can replace maize (Eruvbetine *et al*., 2003; Kwari, 2008) in the diets of pullet layer chickens. The use of agricultural by-products and kitchen wastes like maize bran, rice bran and *Prosopis africana* seed coat meal (PASCM) etc. as feed resources can be achieved in poultry diet after careful study. This will help to reduce the competition for maize and increase animal protein at a relatively lower cost and improve net profit (Dafwang and Shwarmen, 1996; Oluyemi and Roberts, 2000; Diarra *et al.,* 2002; Yusuf *et al.,* 2008).

The availability of PASCM and its free acquisition brings it into focus as a replacement for maize in poultry nutrition. PASCM is high in crude fibre and low in energy compared to maize diet but can be used to replace maize as energy source (Sanni, 2015; Abang *et al.,* 2016) in layer chickens diets with some exogenous enzymes (e.g polyzme®) fortification (Chesson, 1993; Bedford and Morgan, 1996; Classen 1996). This study was sought to provide alternative feedstuffs to address the global feed crisis with the use of PASCM without affecting the economics of production and egg quality characteristics of layer chicken nutrition.

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II. MATERIALS AND METHODS

Experimental Site

The study was conducted at the poultry unit of Ohagwu farm, Ochodu Ukpa Igede, Oju Local Government Area of Benue State, Nigeria. Oju Local Government Area lies between latitude $6^0 51^1$ north and Longitude $8^0 25^1$ east in the Southern Guinea Zone of Nigeria, with a climate that has two distinct seasons. The wet season covers mid-March to mid-November, while dry season starts in late November to early March in which high temperature is experienced between February and April. Oju Local Government Area has an annual rainfall ranging from 1200 mm to1500 mm. The temperatures are generally very high during the day, particularly in March and April with a mean daily temperature of 26^{O}C, and daily minimum temperature of 16^{O}C to 21^{O}C and maximum daily temperature of 31^{O}C to 37^{O}C in dry and wet seasons. The relative humidity ranges from 42% to 75% depending on the time of the day and season of the year (Oju physical Setting Online Nigeria.Com, 2003).

Test ingredient

Prosopis africana seed coat meal (PASCM) was sourced from women in Oju Local Government Area that produced food condiment (Okpehe or Dawadawa) from *prosopis africana* seeds.

Experimental Birds and Management

A total of 300 Nera brown pullet layer chickens were randomly divided into five groups in a complete randomized design with each treatment having three replicates containing twenty birds per replicate. The experimental study which lasted for 39 weeks had five diets that were formulated from a mixture of maize, *Prosopis africana* seed coat meal, soybean meal, rice bran, blood meal, bone meal, palm oil and vitamin/mineral/premix as shown in Table 1. They were intensively managed in deep litter system throughout the experimental period. Feed and water were served*ad libitum*.

Dietary treatment

The PASCM was sundried for 10 days and milled. It was then incorporated into 5 diets at 0, 15, 20, 25 and 30% levels for treatments T_1, T_2, T_3, T_4, and T_5, respectively as replacement for maize. The birds were maintained in deep litter system of five treatments withthree replicates each that were fed on layer mash. Wooden nests were provided for the birds to lay their eggs. Also feeders and drinkers were provided to serve feeds and water respectively. The parameters evaluated in the economics of production were feed intake, feed conversion ratio, percentage hen-day production, percentage daily egg production, age at first egg lay, egg laying period which is the length of laying period, percentage of egg laid per day per treatment and age at peak of egg laying which were obtained in line with the reports of Oladunjoye *et al.* (2008) and Adeyemi *et al*. (2009). Eggs were collected four times daily between 0700 and 1600 hours to prevent breakages.

Egg related data analysis was carried out according to the procedures reported by Oladunjoye *et al*. (2008) and Adeyemi *et al.* (2009). A total number of eggs per replicate were taken for the period of weeks in lay. At the tenth week in lay, one egg per replicate was collected on Wednesday, Thursday and Friday, weighed and broken out for internal and external quality measurements. Egg weight was obtained by using a sensitive top loading mettler –R balance and was determined as average weight of 3 eggs,

shell weight was obtained using a sensitive top loading Mettler–R balance that measures to the nearest decimal point, shell thickness was obtained using a micrometer screw gauge, egg yolk colour index was determined using Roche yolk colour fan, egg yolk cholesterol was determined using the method described by Kim and Goldberg (1969), egg width and egg height were obtained using a venier caliper, albumen height and yolk height were determined using top Spherometer, egg shape index was calculated as thus:

$$\text{Egg shape index} = \frac{\text{Width of egg}}{\text{Length of Egg}} \times \frac{100}{1}$$

Haugh unit (HU) was determined using the formula reported by Oluyemi and Roberts (2000):

$$HU = 100Log\left[H - \frac{\sqrt{G(30W^{0.39} - 100)}}{100} + 1.9\right]$$

Where: H = observed height of albumen in mm

G = gravitational constant (32.2)

W= observd weight of egg in gram.

andmortality rate was recorded where and when it occurred and calculated as the ratio of the number of dead birds to the total number of birds per treatment, expressed as percentage.

Chemical Analysis

Homogenous samples of *Prosopis africana* seed coat meal, T_1, T_2, T_3, T_4 and T_5 diets were subjected to chemical analysis for proximate composition and gross energy determination in the Kappa Biotechnology Laboratory, Research Support R & D and Analytical Service, Trans Amusement Park, Old Airport, Bodija GPO Box 12033, Ibadan, Oyo State, using the standard methods as indicated by A.O.A.C. (2000) and ballistic bomb calorimeter, respectively. *Prosopis africana* seed coat meals and feed

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samples were analyzed for crude protein using Kjeldahl technique; other proximate compositions that were analyzed for include ether extract, crude fiber and ash according to A.O.A.C. (2000) procedure. The nitrogen-free extract (NFE) was obtained by subtracting the % moisture, % crude protein (CP), % crude fiber (CF), % ether extract (EE) and % ash from 100 and difference gave NFE (Aduku, 1993; Esonu, 2000). Metabolizable energy (ME) was calculated using the formula of Pauzenga (1985): (Metabolizable energy (ME) (Kcal/kg) =37 x % CP + 81.1 x %EE +35.5 x %NFE.

Statistical analysis

The data obtained were subjected to one way analysis of variance (ANOVA) in a completely randomized design using the procedure outlined in the Minitab (2014). Where significant difference between treatment means occurred, they were separated using Minitab (2014) software.

III. RESULTS AND DISCUSSION

The Effect of *Prosopis africana*on Economics of Production of Layer Chickens

The effect of dietary PASCM on the economics of production of layer pullet chickens (Table 2) showed that as the PASCM inclusion levels increased and maize decreased in the diets, percentage hen day production (%HDP) and other indices decreased except the FCR, age at first egg production and mortality. Age at first egg production increased with increased levels of maize substitution with PASCM but mortality for birds on PASCM diets (T_2, T_3, T_4 and T_5) did not followed the same decreasing trend with increased in the levels of PASCM. The decrease in the values of these parameters with increased levels of PASCM inclusion in the diets implies that the PASCM may have reduced the efficient utilization of protein and energy of the diets due to its phytonutrients content. This result is in line with the result of Kamdoon (2015)who had reported the impact of phytonutrients of PASCM which was responsible for decrease in feed intake, growth rate, feed efficiency, net metabolizable energy and protein digestibility in laying quails.

The values of %HDP recorded in this study ranged from 34.48 – 64.90 is lower than the range of values (64.97 – 68.47) reported by Okoeguale and Eruvbetine (2009) when unconventional feed supplemented with feed enzyme was fed to layer chickens. The differences in the values of %HDP obtained in this study and the reported values may be due to differences in the strain of birds used. The feed intake in laying hens (g/bird/day) as recorded in this study averaged between 113.32 – 126.35 which is less than the values (120 – 150g/hen/day) reported by Aduku (1993).Average feed intake (AFI) recorded in PASCM based diets (111.27 – 126.35) was slightly higher than the 0% (control diet) (113.32), except in treatment T_4 where AFI was 111.27. AFI observed in this study was higher than the values of 76.70 – 80.11 reported by Adeyemi *et al.* (2009). Feed conversion ratio (feed/dozen egg) obtained in the study ranged from 1.42 – 2.18. Aduku (1993) reported the value of 2.65 in the tropics. FCR in 0% (control diets) showed most superiority over the PASCM based diets and efficiency of FCR decreased with increased levels of PASCM in the diet. This may be due to the PASCM contributory effect of higher fibre content asit replaced energy cereal grain (maize) (Aina, 1990) which necessitates the need for consumption of more feed to meet the energy requirement since birds eat to meet their energy needs (Lesson and Summers, 1997). Moreover, feed enzyme (polyzyme®) inclusion in PASCM based diets could not result in increased digestibility and therefore led to reduction in nutrient uptake. This finding is in support of the work of Okoeguale and Eruvbetine (2009) who observed that supplemented feed enzyme with unconventional feed high in fibre recorded decrease in nutrient digestibility, reduction in nutrient uptake and poor performance.

The number of egg lay per hen (104.19 – 177.49), dozen egg/hen(8.64 – 14.79), hen-housed production (%) (37.48 – 64.90) and percentage egg production (34.73 – 58.40) showed decrease with increased levels of maize replacement by PASCM. This may be due to the fact that the birds become less efficient in utilizing the protein and energy content of the diets for productive functions due to inherent anti-nutritional factors in PASCM. Njoku and Obi (2009) have reported the anti-nutritional factors in PASCM that affect performance in livestock and poultry. Age at first egg laying period (days) increased with increased levels of maize substituted with PASCM. The 0% (control diet) PASCM inclusion level recorded egg production at the age of 133.00 days earlier than T_2, T_3, T_4 and T_5(158.33, 155.69, 168.67, 174.33days, respectively). As the PASCM inclusion levels increased the age at first egg laying production increased. Egg laying period (day) however, decreased with increased levels of maize replaced by PASCM since the age at first egg production occurred earlier with less maize replaced by PASCM in the diets. This result supports the view of Njoku and Obi (2009) who observed that anti-nutritional factors in PASCM reduce performance in livestock and poultry.

Feed cost per dozen eggs decreased with increased levels of maize substituted with PASCM. Treatment T_1 (0% control diet) had the highest feed cost per dozen egg (₦265.72) while

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T_5 (30% PASCM) recorded the least cost (₦ 158.98). This is because the unit cost of PASCM was cheaper than the same unit cost of maize and more also less feed was consumed in PASCM based diets compared to 0%(control diet). This result agrees with the report of Shamwol (2015) who observed that feed cost and cost of feed per gain decreased with increased levels of PASCM in the diets of laying Japanese quails. Hen-housed egg production (%) and percentage egg production decreased with increased inclusion levels of PASCM in the diets. This may be due to the PASCM contributory effect of higher fibre content and other anti-nutritional factors of the feed as it replaces energy cereal grains (Aina 1990) which necessitates the need for consumption of more feed to meet the energy requirement since birds eat to meet their energy needs (Lession and Summers, 1997). Moreover, enzyme inclusion in PASCM based diets (T_2, T_3, T_4 and T_5) could not result in increased digestibility and therefore led to reduction in nutrient uptake.

The egg yolk cholesterol mean values ranged from 226.66 – 263.33mg/100g. The egg yolk cholesterol values were significantly ($P < 0.05$) affected by the dietary treatments. The values decreased linearly across the treatment groups. The highest and lowest values of cholesterol were observed in the groups fed 0% (T_1) and 30% (T_5) PASCM inclusion levels, respectively. The lowest level of egg yolk cholesterol observed in 30% (T_5) PASCM inclusion level could be attributed to high fibre content of PASCM based diets. This result is in line with the report of Idowu *et al. (*2006) who observed that dietary fibre binds with fat and its associates and therefore reduced their assimilation and further deposition in the tissues, organs and products. This result is also in agreement with the hypothesis that increased dietary fibre often result in reduction in the availability of cholesterol for incorporation into lipoprotein (Storey and Furumoto, 1990). This result also shows that there is an inverse relationship between the level of fibre in the diet and the cholesterol level of the egg yolk.

The non-significant ($P > 0.05$) among the treatment means for the mortality observed in this study may imply that the feed was not the cost of the mortality. The diets may have been nutritionally adequate to sustain the hen's health and production despite the high level of crude fibre in the PASCM based diets. This result is in harmony with the finding of Fagbenro and Adebayo (2000) and Akinola and Ekine (2018) who observed that poor quality feed and poor environmental conditions cause high mortality, low productivity, feed condemnation and low rate of return on investment.

Egg Qualities

The observed values of egg weights, egg length, egg width, shell weight and shell thickness in Table 3ranged from 52.24 to 54.61g, 4.28 to 4.50 cm, 4.24 to 4.47cm, 4.19 to 4.35 and 0.45 to 0.46mm, respectively. The non –significant effect of the dietary treatments on most of these parameters is an indication that the nutrient needed for egg production and development were well balanced and utilized by the experimental birds, thus leading to better egg grading which would attract better price. Farooq *et al.* (2001) have showed that egg weight, width, albumin and yolk weights are essential parameters that influence egg quality and grading. The egg length and width are indicators of the egg shape index. There was no variation in the egg length but egg width varied among the dietary treatments and did not follow any particular trend; shell thickness was not significantly different ($P > 0.05$) among the dietary treatments. The egg qualities, according to Akinola and Ekine (2018) may have impacted stiffness of the egg shell and hence reduce egg breakage. The highest yolk colour score obtained in this study is from treatment T_1 (9.05) and least is T_5 (8.07). Yolk colour decreased with increased substitution ofyellow maize with PASCM. The yellow maize used contained carotene content that has the potential to impact yellowish coloration. Bartov and Bornstein (1980) have reported that about 20 – 60% of the nutrients in the feed capable of causing the pigment is transported to the yolk for coloration. Yolk coloring nutrients in feed could be red pepper, pine and yellow corn meal (Blount *et al.,* 2000). Since the acceptable performance of yolk colour for egg is 7 to 8 according to Lesson and Summers (1997), it may implies that all the treatment yolk colour scores (8.07 to 9.05) recorded in this study fall within the acceptable range of 7 to 8. The variation in the values of the other egg quality determinants (Yolk index, yolk: albumin ratio and Haugh unit (HU) did not follow any consistent trend. This implied that the diets supported good quality eggs despite the high content of crude fibre of PASCM. The effect of feed enzyme (Polyzyme®) on PASCM diets may have improved the digestion and utilization of non – starch polysaccharides (NSP) and hence good quality of both the external and internal egg indices (Akinola and Ekine, 2018).

IV. CONCLUSION

The results of this study showed that most of the productive parameters showed decrease with increased levels of PASCM inclusion in the diets except for mortality and feed intake that did not show decrease.External egg quality parameters did not show variation except the egg width but

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most of the internal egg qualities exhibited variations. From the results obtained on the effect of PASCM on the layer economics of production and egg quality characteristics, it may be concluded that20% PASCM level of inclusion is recommended for optimum productivity since egg production constitutes the main index in layer chicken production.

Table1: Ingredients and Dietary Composition of Pullet Layer Chicken Diets Experimental diets

Ingredients	0%	15%	20%	25%	30%
Maize	54.00	45.90	43.20	40.50	37.80
PASCM	-	8.10	10.80	13.50	16.20
Sobean meal	20.00	20.00	20.00	20.00	20.00
Rice bran	14.00	14.00	14.00	14.00	14.00
Palm oil	1.00	1.00	1.00	1.00	1.00
Blood meal	2.00	2.00	2.00	2.00	2.00
Bone meal	5.00	5.00	5.00	5.00	5.00
Limestone	3.00	3.00	3.00	3.00	3.00
Vit./Min/permit	0.25	0.25	0.25	0.25	0.25
Salt (Nacl)	0.30	0.30	0.30	0.30	0.30
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.25	0.25	0.25	0.25	0.25
Enzymes	-	+	+	+	+
Total	100.00	100.00	100.00	100.00	100.00
Analyzed nutrients					
Dry matter	88.58	87.29	87.52	89.90	86.64
Crude protein	16.33	16.64	16.92	17.06	16.40
Crude fibre	4.48	5.59	5.12	5.47	5.48
Ether extract	3.41	3.76	4.42	4.33	4.52
Ash	12.19	11.38	11.13	11.74	11.86
Nitrogen-free Extract (NFE)	62.50	62.64	62.40	61.35	61.6
ME (kcal/kg)*	3099.51	3144.34	3199.70	3160.31	3160.17

ME:metabolizable energy

PASCM = *Prosopis africana* seed coat meal

- Vitamin/mineral premix supplied the following additional nutrients per kg of feed.

Table 2: Effect of Prosopis Africana on Economics of Production of Layer Chickens

Parameter	Experimental Diets T_1	T_2	T_3	T_4	T_5	SEM
% HDP	64.90[a]	53.27[b]	50.02[b]	47.72[b]	37.47[c]	2.10
No of egg laid/hen	177.49[a]	145.44[b]	136.55[b]	130.00[b]	104.18[c]	0.00
Dozen egg/hen	14.79[a]	12.12[b]	11.38[b]	10.84[b]	8.68[c]	0.70

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% Mortality	10.00	11.66	10.00	10.00	10.00	0.00
% egg production	58.40^{a}	46.97^{b}	44.93^{bc}	42.88^{c}	34.93^{d}	0.00
Average feed intake(g/bird/day)	119.34	110.56	107.52	107.70	106.25	0.43
FCR 1.8kg feed/dozen egg	1.42^{a}	1.71^{a}	1.75^{a}	1.83^{ab}	2.18^{b}	0.04
% hen day house production	58.40^{a}	48.97^{b}	44.93^{bc}	42.88^{c}	34.93^{d}	0.06
Feed cost/dozen egg(₦)	265.72^{a}	215.88^{b}	204.44^{bc}	195.14^{c}	158.94^{d}	0.20
Age of first egg lay (days)	133.00^{c}	158.33^{b}	155.66^{b}	168.66^{a}	174.33^{a}	0.50
Egg laying period	278.33^{a}	252.66^{b}	255.00^{b}	244.66^{bc}	237.00^{c}	0.09
Age at peak of laying	240.00^{b}	251.33^{ab}	254.33^{ab}	264.66^{a}	259.66^{a}	0.04
Yolk cholesterol (mg/100g)	263.33^{a}	256.66^{b}	250.64^{bc}	247.21^{c}	237.12^{c}	0.01

abcd means with different superscripts in the row are significantly different ($p<0.05$)
% HDP = percentage hen production
AFI = Average feed intake
Number (No.) of egg laid/hen
FCR = Feed conversion ratio

Table 3: Effect of Prosopis africana on Egg quality of Layer Chickens

Performance indices	Experimental Diets					
TRT	T_1	T_2	T_3	T_4	T_5	SEM
External qualities						
Egg weight (g)	53.41	54.61	52.24	52.31	53.09	0.62
Egg length (cm)	4.42	4.28	4.44	4.42	4.50	0.00
Egg width (cm)	4.24^{bc}	4.23^{c}	4.25^{bc}	4.40^{ab}	4.47^{a}	0.02
Shell weight (g)	4.34	4.27	4.19	4.29	4.35	0.10
Shell thickness (mm)	0.45	0.45	0.45	0.46	0.46	0.02
Internal qualities						
Yolk height (mm)	2.76^{b}	2.78^{b}	2.71^{b}	2.89^{a}	2.89^{a}	0.03
Yolk weight (g)	13.73^{b}	13.86^{b}	14.20^{a}	14.39^{a}	14.47^{a}	0.02
Yolk diameter (cm)	4.04^{ab}	3.98^{b}	3.97^{b}	4.04^{ab}	4.09^{a}	0.08
Yolk index	68.33^{b}	69.92^{ab}	68.34^{b}	71.62^{a}	70.53^{a}	0.01
Albumin height (mm)	3.02^{b}	3.03^{b}	3.06^{b}	3.18^{a}	3.22^{a}	0.39
Albumin weight (g)	33.94^{b}	34.54^{a}	34.74^{a}	34.91^{a}	34.86^{a}	0.02
Yolk colour	9.05^{a}	8.88^{b}	8.65^{c}	8.41^{d}	8.07^{e}	0.00
Egg shape index	8.17	7.85	8.02	8.21	8.20	0.09
Haugh unit	80.78^{a}	71.81^{b}	69.14^{b}	66.54^{b}	71.26^{b}	1.64
Yolk:albumin ratio	0.40	0.40	0.41	0.41	0.42	0.10

$^{a,b,c,d:}$Means with different superscript in the same row are significantly different ($P<0.05$); SEM = Standard error of mean

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REFERENCES

[1] Abang, F.B.P, Ikwume T. and Ira-Ibor, B.O (2016). Cancass and Organ Characteristics of growing Japanese quail (coturnix coturnix japonics) fed diets containing boiled *Prosopisafricana* seed coat meal. *Global Journal of Agriculture Research,* 4(6); 1-6.

[2] Abu, D. O. 2016). Carcass and organ characteristics of broiler chickens fed *Prosopis africana* pod meal treated with rumen content. B. Agric., Department of Animal Production, College of Animal Science, Federal University of Agriculture, Makurdi, Benue State, Nigeria.

[3] Adeyemi, O. A., Agunbiade, J. A. and Oyefeso, A. O. (2009). Performance and early lay characteristics of growing pullets. In: Nigeria Poultry (Ola, S. I., Jegede, A. V. and Fafiolu, A. O., Eds.). *Official Journal of the Worlds' poultryScience Association-Nigeria Branch*, 6: 24 – 31.

[4] Aduku, A. O. (1993). *Tropical feedstuff analysis Table*. Department of Animal Science, Faculty of Agriculture, ABU, Samaru, Zaria, Nigeria.

[5] Aina, A. B. J. (1990). Replacing maize with cassava peels in finisher ration of cockerels. The effect on Cut off-pieces of the eviscerated cassava. *Nigeria Journal of Animal Production,* Vol. 17:17 – 22.

[6] Akinola, L. A. F. and Ekine, O. A. (2018). Evaluation of commercial layer feeds and their impact on performance and egg quality. *Nigerian Journal of Animal Science,* 20(2): 222 – 231.

[7] Aletor V.A (2005) Alternative energy and protein feed resources in livestock feeding. A Revisit of Possibilities and Annual Conference of Annual Science Association of Nigeria held at the University of Ado-Ekiti, Ekiti State 13th September, 2005.

[8] AOAC (2000).*Official Methods of Analysis*.17thEdition.Association of Official Analytical Chemists. Washington, D.C.

[9] Bedford, M. R. and Morgan, A. J. (1996). The use of enzymes in poultry diets. *World Poultry Science Journal*, 52: 61 – 68.

[10] Chesson, A. (1993). Feed Enzyme. *Animal Feed Science Technology,* 45: 65-79.

[11] Classen, H.L. (1996). Cereal grain starch and exogenous enzymes in poultry diets. *Animal Feed Science Technology*, 62: 21-22.

[12] Dafwang, I.I and Shwarmen, E.B.N. (1996). Utilization of rice offal in practical rations for broiler chicks. *Nigerian Journal of Animal Production,* 23:21-23.

[13] Diarra, S.S., Kwari, I.O and Ubosi C.O. (2002). Potential of millet bran as substitute for wheat bran in broiler chicken diets. *Journal of Sustainable Agricultural Environment,* 4: 165 – 169.

[14] Esonu, B. O. (2000). *Animal Nutrition and Feeding:A Functional Apprroach.* Rukzeal and Ruksons Associate Memorial Press, Oweri, Nigeria.

[15] Eruvbetine D., Tajudeem I.O ., Asdeosu, A.T. and Oloyede, A.A. (2003). Cassava (Manihot esculenta) leaf and tuber concentrate diets for broiler chickens. *Bio-resources Technology*, 86: 277 – 281.

[16] Fagbenro, O. A. and Adebayo, O. T. (2000). Areview of the animal and aquatic industries in Nigeria. FAO Corporate Document Repository.

[17] Idowu, O. M.O, Idowu, O. A., Oso, A. O., Fafiolu, A. O., Sule, R., Sorongbe, A. and Eruvbetine, D.(2006). Performance of laying hens fed cassava root wastes. *Nigerian Poultry Science Journal,* 4: 48-55. World's Poultry Science Association –Nigerian Branch.

[18] Kamdoon, I.B. (2015).The effect of feeding treated *Prosopis africana* seed coat meal on the haematological parameters of laying Japnese quails (Coturnix coturnix Japonics). B. Agric., Department of Ainmal Production, College of Animal Science, Federal University of Agriculture, Makurdi, Benue State, Nigeria.

[19] Kwari, I.D. (2008). Alternative energy feed resources in feeding poultry. Ph.D. Non-Thesis seminar. A paper presented at the Department of Animal Science, Faculty of Agriculture, University of Maiduguri, Maiduguri, Borno State, Nigeria.

[20] Lakurbe, O. A., Doma, U. D., Bello, K. M. and Abuber, M. (2018). Carcass characteristics and blood components of broiler chickens fed sorghum SK-5912 (Sorghum bicolor I. Moeneh) variety in mixture with different plant protein sources. *Nigerian Journal of Animal Science,* Vol. 20(2):250 – 257.

[21] Lesson, S. and summers, J. D. (1997). *Commercial Poultry Nutrition*. 2nd ed. University Books, University of Guelph, Guelph, ON, Canada; feeding programs for broilers. Pp. 207 – 254.

[22] Minitab (2014). Minitab statistical software manual. C. Version. Release 16, New York Media Cybernetics.

[23] Musa, R. R. and Olarinde, L. O. (2008). Cost and return implications in poultry farming in Ido Local Government Area of Oyo State. In: *Animal Agriculture towards Millennium Development in Nigeria(*Adeyemi, O. A., Ogungbean, R. M., Dada, R. O., Emolorunda, O. O., Awojibi, H. A., Ore, O. B. and Agunbiade, J. A. eds.). Proceeding of the 33rd Annual conference of the Nigerian Society for Animal production held at the College of Agricultural Science, OlabisiOnabanjo University, Ogun State, Nigeria, Pp. 312-315.

[24] Njoku, V. O. and Obi, C.(2009). Phytochemical constituents of some selected medical plants. *Academic Journal of Pure and Applied Chemistry*, 3(11):228-233.

[25] Odeh, M. O., Igwebuike, J. U., Ubosi, C. O. and Akwukwaegbu, S. E. (2012). Performance, digestibility and carcass characteristics of broiler chickens fed with graded levels of rice milling waste. *Katsina-Ala Multidisciplinary Journal*, 1 (2):38- 50.

[26] Oju (2003). Oju physical online, Oju LGA, Benue State SA3. Last edited on September 2015,at20:41,Time Zone WAT (CTC+1). *Oju Physical Setting Online. Com* 29 Jan.

[27] Okoeguale, A. W. and Eruvbetine, D. (2009). Performance and egg quality characteristics layers fed enzyme supplemented with unpeeled cassava root meal based diets. *Poultry industry in West Africa.* In: Towards Millennium Development Goals (Ola, S.I., Fafiolu, A. O. and Fatufe, A. A. Eds.). Book of Proceeding, 3rd Nigerian International Poultry Summit. Pp. 114 – 118.

[28] Oladunjoye, I. O., O Jebiyi, O. O. and Odunsi, A. A. (2008). Performance characteristics and egg quality of laying chickens fed lye treated cassava (*Manihot esculenta* Cranz) peel meal. Proceedings of the 13th Annual Conference of the Animal Science Association of Nigeria (ASAN), 15th – 19th September. ABU, Zaria, Kaduna State.

[29] Oluyemi, J. A. and Roberts, F. A. (2000). *Poultry production in Warm wet climates,* 2nd Edition, spectrum Book Ltd, spectrum House Ring Road Ibadan, Nigeria, 176Pp.

[30] Pauzenga, U. (1985). *Feeding parent stock*. *Zoo-tech. International*, Pp. 22-25.

[31] Sanni, O.M. (2015). The effect of Iron tree (*Prosopis africana*) sees meal on the performance characteristics of laying Japanese quails (coturnic coturnix Japonica:. B. Agriculture, Department of Annual Production. Federal University of Agriculture, Makurdi, Benue State, Nigeria.

[32] Shamwol, E. L. (2015). Economic production of laying Japanese quails (Coturnix coturnix japonica) fed treated *Prosopis africana* seed coat meal. B. Agric., Department of Animal Production, College of Animal Science, Federal University of Agriculture, Makurdi, Benue State, Nigeria.

[33] Storey, J. A. and Furumoto, E. J. (1990). *Dietary fibre and bile acid metabolism*. Pages 364 – 365. In: dietary fibre Chemistry, Physiology and Health effects. Eds. Kritchevsky, D., Bonfield, C. and Anderson, J. W. Plenum Press; N. Y.

[34] Torres, A. A., Pizauro, J. M., Sores, Silvo, T. G. A. and Nogueira, W. C. L.(2013). Effects of corn replacement by sorghum in broiler chicks on performance and internal muscosa integrity. *Poultry Sciences*, 9: 1564 – 1571.

[35] Yusuf, A.L. Tukur H.M., Abubakar, A. and Olarede, B. (2008). Energy requirement of layer chicks in a serni-and environment. Repositioning Animal Agriculture for the Realiszation of National Vision 2020. In: Proceeding of the 13th Annual Conference of Animal Science Association of Nigeria (ASAN) (Bawa, G.S., Akpa, G.N., Jokthan, G.E., Kabir, M. and Abu, S.B., Eds.), September, Pp. 15 – 19.

[36] Yunusa, Y., Doma, U. D., Zahraddreen, D., Umar, A. and Abubar, S. B. (2014). Carcass and gut characteristics of broiler chickensfed different energy sources. International Journal of Poultry Sciences, 13(9): 525 – 529.