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Performance and Carcass 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 performance and carcass characteristics of three hundred (300) Nera brown layer chickens that were fed for a period of 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 all the productive parameters were affected ($P < 0.05$) by the dietary treatments except mortality that was not affected ($P > 0.05$). Carcass parameters, carcass cut and internal organs were not affected ($P > 0.05$) by the dietary treatments however, GIT parts were affected ($P < 0.05$) by the diets. Performance indicators and carcass characteristics showed that 20% PASCM inclusion level resulted in optimum production and hence recommended for adoption.*

Keywords— ***PASCM, Pullet Layer Chickens, Performance and Carcass 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 investing in 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 performance and carcass characteristics in layer chicken nutrition.

II. MATERIALS AND METHODS

Experimental Site

This 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^{0}C to 21^{O}C and maximum daily temperature of 31^{O}C to 37^{0}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 were feed intake, feed conversion ratio, percentage hen-day production (%HDP), 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, percentage hen house production(%HHP) 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.

Carcass Analysis

At the end of the experiment, three layer chickens from each treatment (i.e. one from each replicate) were randomly selected and slaughtered. The live-weight, plucked weight, dressed weight, cut-up parts and organs were weighed and measured. The cut up parts were individually expressed as percentage of the plucked weight while organ weights were expressed as the percentage of the live weight.

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 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.

Results and discussion

The Performance Indices of Layer Chickens Fed Diets Containing *Prosopis africana* Seed Coat Meal

The effect of dietary PASCM on the performance of laying pullets (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 level of PASCM. The decrease in the values of these parameters with increased level of PASCM inclusion in the diets implies that the PASCM may have reduced the efficient utilization of protein and energy of

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the diets due to its phytonutrients content. This result is in line with the result of Kamdoon (2015) 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 higher than the values of 76.70 – 80.11 reported by Adeyemi *et al.* (2009) but comparable with the values (120 – 150) reported by Aduku (1993). Feed conversion ratio (feed/dozen egg) obtained ranged from 1.42 – 2.18. Aduku (1993) reported value of 2.65. 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). More so, 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) 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 became 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) and Sanni 2015) 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, 174.33 days, 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) and Sanni (2015) 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 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 produced 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). More so, 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. (*2000) 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.

Carcass Parameters of Layer Chickens

Result of carcass yield of layer chickens fed on diets containing *Prosopis africana* seed coat meal is presented in Table 3and showed that the live weight, pluck weight, dresses weight, visceral weight and dressing percentage that were not significantly (P > 0.05) affected by the dietary treatments. The dressing percentage varied from 53.59% to 60.63% in the birds fed the experimental diets. The results obtained for dressing percentage in this study were similar across the dietary treatments. These results are in agreement with that of Torres *et al.* (2013) and Lakurbe *et al.* (2018) who reported that there were no significant different (P > 0.05) among the treatments in the whole carcass or weight of carcass parts of broiler chickens fed on sorghum based diets as energy source.

Carcass Cut of Layer Chickens

The evaluation of carcass cut of layer chickens in Table 4 showed that only the breast cut was significantly (P < 0.05) affected by the dietary treatments. This result agrees with the report of Abu (2016) who showed that there were no-significant different in meat yield and meat distribution among carcass cut or the proportional weight of the major visceral organs of broiler birds fed on *Prosopis* pod meal. The non – significance for most of the carcass cut determined in this study, according to Lakurbe *et al.* (2018) is an indication that the dietary treatments have no adverse effect on the parameters under investigation.

Internal organs

The result of the internal organs of layer chickens evaluated is presented in Table 5 and it showed that the liver, lung, heart, spleen, fat and caecum were not affected (P > 0.05) by the dietary treatments however, the kidney, pancreas, Proventriculus, gizzard, empty gizzard, large intestine and small intestine were significantly (P < 0.05) affected by the dietary treatments. The kidney which is an organ of detoxification, showed variation but was not significantly different from treatment 0% (control diet) PASCM inclusion level. This is an indication that PASCM was not toxic enough to cause increase in the size of the kidney. Also some internal organs showed variation among treatment means, there was no consistent trend established. The variation among the treatments according to Yunusa *et al.* (2014) may not be due to different energy sources but probably due to varietal and individual differences among birds in feed consumption.

Gastro-Intestinal Tract (GIT)

The GIT length, small intestine, and large intestine that were expressed as the percentage of GIT length were affected (P < 0.05)by the dietary treatments however caecum that was also expressed as the percentage of GIT length did not show significant different (P > 0.05) among the dietary treatments. The indices of the GIT that showed variation did not follow any consistent trend. Therefore the variation may be due to individual differences in feed consumption rather than the effect of diets on the GIT indices. This result confirms with the result of Yunusa *et al*. (2014) who reported variation in characteristics including the GIT indices of avian species, fed different energy sources suggested that the difference may be due to varietal and individual differences.

III. CONCLUSION

The results of this study showed that most of the productive parameters were affected (P < 0.05) by the dietary treatments. Mortality was not affected (P > 0.05). Carcass yield, carcass cut and internal organs were not affected (P > 0.05) by the dietary treatments but GIT parts were affected (P < 0.05) by the diets. From the results obtained on the effect of PASCM on the layer performance and carcass characteristics 20% PASCM level of inclusion is recommended for optimal productivity since egg production constitutes the main index in layer chicken production.

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Table1: Ingredients and Dietary Composition of Pullet Layer Chicken Diets

Ingredients	Experimental diets 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 Experimental Diet on Productive Parameters 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
% 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
Date 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

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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

HHEP = Hen-Housed egg production (%)

Table 3: Effect of Prosopis africana on Carcass Parameters of Layer Chickens

Carcass yield	Experimental Diets					
	T_1	T_2	T_3	T_4	T_5	SEM
Live wt (g)	1900.00	1933.30	1833.30	1733.30	1866.70	36.34
Pluck wt (g)	1535.00	1571.30	1506.70	1489.30	1551.70	43.10
Dressed wt (g)	1150.67	1125.33	1075.67	1051.33	998.33	30.10
Visceral wt (g)	1205.00	1215.30	1161.00	1135.70	1076.30	30.85
Dressing %	60.46	58.21	58.54	60.63	53.59	1.12

Wt = weight

SEM = Standard error of mean

Table 4: Effect of Prosopis africana on Carcass Cut of Layer Chickens

Carcass cut (% DW)	Experimental Diets					
	T_1	T_2	T_3	T_4	T_5	SEM
Breast	24.43^{b}	29.42^{a}	24.72^{b}	26.39^{ab}	25.51^{ab}	0.69
Back	16.12	16.86	16.00	16.41	16.69	0.20
Thigh	12.77	12.63	12.87	12.92	13.07	0.20
Drum stick	11.86	12.44	12.40	12.69	12.64	0.15
Neck	8.27	8.19	8.58	8.18	8.17	0.17
Shank	3.33	3.46	3.49	3.67	3.41	0.06
Head	4.18	4.45	4.55	4.29	4.35	0.11
Wing	12.21	11.81	11.43	11.24	10.95	0.24

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

SEM = Standard error of mean

DW = Dressed weight

Table 5: Effect of Prosopis africana on Internal Organs of Layer Chickens

Internal Organs (% LW)	Experimental Diets					
	T_1	T_2	T_3	T_4	T_5	SEM
Liver	2.06	2.26	1.85	2.33	2.56	0.15
Lungs	0.51	0.43	0.50	0.52	0.47	0.01
Heart	0.72	0.59	0.61	0.60	0.57	0.02
Kidney	0.73^{a}	0.67^{ab}	0.75^{a}	0.78^{a}	0.52^{b}	0.03
Spleen	0.08	0.06	0.05	0.05	0.09	0.01
Pancreas	0.21^{ab}	0.17^{ab}	0.23^{a}	0.21^{ab}	0.12^{b}	0.01
Proventriculus	0.43^{ab}	0.44^{ab}	0.50^{a}	0.34^{b}	0.35^{b}	0.01
Gizzard	3.65^{ab}	3.89^{ab}	3.86^{ab}	4.26^{a}	3.30^{b}	0.12
Empty gizzard	2.24^{ab}	2.10^{b}	2.35^{ab}	2.67^{a}	1.94^{b}	0.08

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Fat	1.47	0.68	0.45	0.68	0.75	0.20
Large intestine (g)	0.76^{ab}	0.82^{ab}	0.91^{ab}	1.02^{a}	0.60^{b}	0.05
Small intestine (g)	3.42^{ab}	4.51^{ab}	4.66^{a}	4.39^{ab}	2.96^{b}	0.25
Caecum (g)	0.82	0.65	1.39	0.95	0.87	0.11

^{a,b} Means with different superscript in the same row are significantly different (P<0.05)

SEM = Standard error of mean

LW = Live weight

Table 6: Effect of Prosopis africana on GIT Parts of Layer Chickens

GIT parts	Experimental Diets					
	T_1	T_2	T_3	T_4	T_5	SEM
GIT length (cm)	203.67^{b}	228.67^{a}	249.00^{a}	242.33^{a}	201.67^{b}	5.94
Small intestine (%GIT)	70.28^{b}	79.07^{a}	77.10^{a}	75.75^{ab}	76.78^{a}	0.19
Large intestine (% GIT)	7.02^{a}	5.98^{ab}	5.48^{b}	6.59^{ab}	6.29^{ab}	1.03
Caecum (% GIT)	19.50	17.19	16.68	16.65	18.65	0.63

^{a,b} Means with different superscript in the same row are significantly different (P<0.05)

SEM = Standard error of mean

GIT = Gastro intestinal tract

T_1 = Control diet

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