PERFORMANCE RESPONSE AND EGG QUALITIES OF LAYING BIRDS FED ENZYME SUPPLEMENTED PALM KERNEL CAKE (PKC) BASED DIETS

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ABSTRACT

The performance response and egg qualities of laying birds fed enzyme supplemented PKC diets as replacement for maize was investigated with 210, 20 week old laying pullets of Dominant Black strain at the Teaching and Research Farm of the Delta State University, Asaba Campus, Nigeria. The birds which just come into lay were randomly allotted into seven dietary groups of 30 each in three replicates. The experiment was conducted for 11 weeks. Dietary treatments significantly ($p<0.05$) affected feed intake, Hen day percent, Egg weight, Feed efficiency (Kg feed: Kg eggs) and cost of feed per egg. Final live weight and body weight gains at end of the experiment were similar ($p<0.05$) among treatments. On egg qualities, only Haugh unit was significantly ($p<0.05$) improved with increased level of PKC which appeared to be better as rate of enzyme supplementation increases. The differences observed in the experiment on performance parameters appeared not to have established a consistence trend to strongly assert a conclusion but are indicative of the possibility of replacing maize with PKC in a laying birds diet up to 40 % when supplemented with Hemicell® enzyme. Other enzyme application methods may be investigated to see if better performance response trend can be achieved.

Keywords: Performance response, Egg qualities, Laying birds, Palm kernel cake, Enzyme

INTRODUCTION

There is no doubt that the animal protein need of Nigerians will continue to increase. The need to increase animal production aggressively is an understatement if the already shortfall in protein intake of the average Nigerian and the continuous increase in the nation's population are considered. Increased animal production may only be possible with adequate nutritional provision for the livestock of which poultry is very significant. Adequate nutrition with conventional feedstuffs (maize, soyabean meal, and fishmeal) is extremely expensive and could make animal products unaffordable. Therefore, alternative feed sources which are cheap, biologically qualitative or that can be enhanced and did not form food for man are the interest of nutritionist. Palm kernel cake, a bye- product of oil processing has adequate energy and protein content and is readily available. It however contains high level of fiber (12%) with a β-mannanqase concentration of 30% which is regarded as a powerful antinutritive fiber (McDonald *et al.,* 1995; Chot, 2006). In addition, the total Non-Starch Polysaccharide (NSP) level reaches 70%. These factors in PKC seem to affect its utilization in monogastrics especially in poultry feeding.

The use of enzymes has however been credited with possible enhancement of feed ingredients and improving performance of livestock to which they are fed (Sundu *et al.,* 2006). This however is not always the case. The appropriateness of enzyme to the ingredient is an important factor in the effectiveness of the enzyme. Linden (2005) reported that the utilization of Hemicell a β-mannanase/xylanase improved the performance equivalent of at least 100Kcal/kg increase in ME and uniformity was also improved. Since PKC contains a substantial concentration of β-mannan and high level of total NSP, the supplementation of PKC diet with Hemicell is expected to illicit improved utilization of the ingredient and improved performance.

Hemicell® supplementation of graded levels of PKC as replacement for maize with 0.05% enzyme level did not achieve an expected improvement in a broiler experiment (Akpodiete *et al.*; 2006). A higher level of enzyme supplementation was suggested. Hence this experiment was carried out to considered three enzyme (Hemicell®) supplementation levels on two PKC replacement levels in laying pullets diet.

MATERIALS AND METHODS

Site of Study: The experiment was conducted at the Poultry Unit of the Teaching and Research Farm of the Delta State University, Asaba Campus, Delta State, Nigeria. The farm is located on longitude 60º 45´ E and latitude 60º 12´ N with an annual rainfall range of 1800mm to 3000mm and maximum day temperature of 27.5º C to 30.9ºC. Experimental Animals, Design and Management: A total of two hundred and ten 20 weeks old pullet birds of "Dominant black" were used for the study. They were divided into 7 groups of 30 birds in three replicates assigned into a completely randomized design. The birds were managed in deep litter system in a standard tropical open sided poultry house partitioned into 21 spaces with wire mesh to prevent mixing up. Normal management procedures as outlined for the tropics by Oluyemi and Roberts (2000) for laying birds were adopted. The experiment lasted for 11 weeks.

Experimental Diets: three based diets were formulated to contained 0%, 20% and 40% PKC as replacement for maize in layer diet. The 0% PKC diet served as control. Three enzyme levels; 50g, 60g and 70g per 100kg of feed were supplemented to the 20% and the 40% PKC diets respectively. Thus, the 20% and the 40% PKC based diets now have 3 diets each diets respectively differing only by their enzyme concentrations giving a total dietary units of 7 (Table 1). Each of the dietary units was assigned to feed the seven groups of birds. The diets were formulated to supply 2600Kcal/kg ME and 17% crude protein.

Data Collection and Statistical Analysis: The birds were weighed at the beginning and end of the experiment to obtain the body weight and weight gains. Feed consumption was taken at the end of each week by subtracting the amount of feed left-over from the pre-weighed feed and divided by the number of birds per replicate. Egg production records were collected as the number of eggs laid per replicate, weighed and used to calculate the Hen day percent and egg weight for the period. Feed efficiency in term of egg was calculated per Kg weight of eggs and cost of feed per egg was computed from the prevailing market prices as at the time of the experiment. Internal qualities of egg were determined weekly for the four last weeks of the experiment on replicate basis and poled for the average values. Albumen weight and height, yolk weight, length and breath used for yolk index calculation; shell weight and thickness were measured and egg shape index, egg shape index (ESI), was calculated as egg breath divided by egg length. Haugh unit was calculated from the expression: $Hu = 100\log (H+ 7.57 – 1.7W^{0.37})$ where H = height of albumen (mm), W = weight of egg (g); shell surface area (SSA) was determined according to Lewis and Perry (1987) as $EW^{0.667} \times 4.67$ while yolk colour was subjectively scored by three persons using the Roche Colour Fan for the 4 weeks and the average recorded. All data were obtained on replicate basis. The obtained data were subjected to analysis of variance using IRISTAT statistical package. Means were separated using LSD at 5% probability level.

RESULTS AND DISCUSSION

The results of the performance characteristics are presented in Table 2. The initial live weight, final live weight and weight gains of birds fed the different dietary treatments were not significantly ($P > 0.05$) different among treatment means. Feed intake, hen-day production, egg weight, feed efficiency per Kg eggs were all significantly ($P < 0.05$) affected by the dietary treatment. Feed intake was highest ($P < 0.05$) for birds in treatment 3 where 20% PKC replacement level was supplemented with 60g of Hemicell® enzyme when compared with the 50g and 70g enzyme supplementation of same PKC replacement level but all other treatments were not differently ($P > 0.05$) affected. The response of the pullets to feed intake which was expected to increase with increase PKC inclusion levels (Ezishi and Olomu, 2004; Sundu *et al.,* 2005) did not follow suit. In fact, pullets fed the PKC diets with the exception of the treatment 3 group tend to eat less ($P > 0.05$) than the control with no PKC inclusion. This perhaps might be as a result of the enzyme supplementation which may have enhanced the quality of the PKC. However, there was no indication to whether increased enzyme supplementation levels improve the PKC utilization at the two levels of replacement. Nevertheless, the similarities in the weight gains of all treatment groups indicated that pullets effectively utilized the PKC diets even at 40% replacement level comparatively to the control diet. Hen-day production appeared to decline with increase PKC inclusion level which was significantly ($P < 0.05$) reduced in treatments 3, 5 and 7. Hen-day production of pullets was poorest in treatments 5 and 7 with 73% hen-day when 40% PKC was included in the diets. Treatment 6 which also had 40% PKC but 60g enzyme supplementation was closest to control diet in hen-day production with 88% compared to 92%. These were not significantly ($P > 0.05$) differently. While the results tend to show a poorer performance index with PKC utilization, the exceptional higher performance recorded for treatment 6 could hardly be explained. It can not be specifically attributed to enzyme supplementation. This is because hen-day production did not established any trend strongly tied to enzyme inclusion. At 20% PKC inclusion level, hen-day for pullets in the group supplemented with 60g enzyme was lower than those on 50g and 70g per 100Kg feed supplementation. Nonetheless, the general performance on hen-day production falls within the range reported in the tropics (Oluyemi and Roberts, 2000).

The results of the egg weights of pullets fed the experimental diets were not significantly ($P < 0.05$) different among all treatment means. This implied that nutrients supply from PKC diets are comparably utilized by pullets in all treatments as nutrient deficiency especially protein and methionine will affect egg size (Oluyemi and Roberts, 2000). Feed efficiency was significantly ($P < 0.05$) affected but did not follow any trend attributable to either PKC inclusion levels or enzyme supplementation rate. Feed efficiency for birds fed T2 and T4 (which had 20% PKC) but 50g and 70g enzyme supplementation respectively) and T6 (which had 60g enzyme supplementation at 40% PKC inclusion level) were similar ($P > 0.05$) to control but were significantly ($P<0.05$) better than other groups. Onifade and Babatunde (1998) and Sundu *et al.* (2005) had reported a decreased feed digestibility, apparent nitrogen retention and apparent calcium retention with increased level of PKC in broilers. The decreased feed digestibility was suggested to be due to broiler chickens limited ability to digest dietary fiber, such as β-mannan because of the absence of mannan degrading enzyme in their digestive tract (Sundu *et al.,* 2006). Therefore, the feed efficiency obtained for birds in this experiment in which there were comparable results even at 40% PKC inclusion may not be unconnected with the enzyme supplementation in these diets.

The cost of compounding a Kg of feed and cost of feed consumed per bird decreased ($P < 0.05$)

Table 1: Composition of Experimental Layer Diets

Ingredients(%)	0% T1	20% T2	20% T3	20% T4	40% T5	40% T6	40% T7
Maize	53.30	42.64	42.64	42.64	31.98	31.98	31.98
Soyabean meal	18.00	16.00	16.00	16.00	14.00	14.00	14.00
Palm kernel cake	—	10.64	10.64	10.64	21.32	21.32	21.32
Wheat Offal	14.50	13.50	13.50	13.50	12.30	12.30	12.30
Bone meal	3.00	4.50	4.50	4.50	6.00	6.00	6.00
Oyster shell	7.50	9.00	9.00	9.00	10.70	10.70	10.70
Fixed ingredients	3.70	3.70	3.70	3.70	3.70	3.70	3.70
Enzyme(Hemicell)	—	+	++	+++	+	++	+++
Calculated composition							
Energy(MEKcal/Kg)	2673	2573	2573	2573	2257	2257	2257
Crude Protein (%)	17.34	17.25	17.25	17.25	17.13	17.13	17.13
Calcium (%)	3.90	3.91	3.91	3.91	3.93	3.93	3.93
Phosphorus (%)	0.87	1.16	1.16	1.16	1.45	1.45	1.45
Methionine (%)	0.55	0.50	0.50	0.50	0.58	0.58	0.58
Lysine (%)	0.90	0.87	0.87	0.87	0.85	0.85	0.85
Fibre (%)	3.50	4.35	4.35	4.35	5.18	5.18	5.18

Fixed ingredients: Fishmeal, 3%; methionine, 0.25; salt, 0,20; premix, 0.25; Premix(Agricare-Mix): Vit. A, 10000i.u; Vit.$D_{3,}$ 2000i.u; Vit.E, 5i.u; Vit.K, 2mg; Vit. $B_{2,}$4.2mg; Vit.$B_{12,}$ 0.01mg; nicotinic acid, 20mg; folic acid, 0.05mg; choline,3mg; Mg,56mg; Fe,20mg; Cu,1.0mg; Zn,5.0mg; Co,1.25mg; Iodine,0.8mg. +(50g), ++(60g), +++(70g) Hemicell enzyme levels/100kg of feed.

Table 2: Performance Characteristics and Cost Analysis of Laying Pullets Fed Experimental Diets

Parameter	0% T1	20% T2	20% T3	20% T4	40% T5	40% T6	40% T7	SEM	Level Of Sig
Initial Lwt/bird(Kg)	1.52	1.53	1.53	1.53	1.53	1.46	1.48	0.08	n.s
Final Lwt/bird (Kg)	1.67	1.63	1.63	1.63	1.71	1.58	1.56	0.12	n.s
Weight gain/bird{Kg)	0.14	0.10	0.10	0.10	0.18	012	0.08	0.04	n.s
Feed Intake/bird/wk(Kg)	0.85^{ab}	0.80^{b}	0.87^{a}	0.80^{b}	0.82^{ab}	0.81^{ab}	0.82^{ab}	0.07	*
Hen-day Prod. (%)	92.18^{a}	84.01^{ab}	76.59^{bc}	82.35^{ab}	73.96^{c}	88.30^{a}	73.04^{c}	3.44	*
Mortality (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Egg weight(g)	58.10	57.67	56.25	56.86	56.68	57.05	57.25	0.67	n.s
Feed efficiency/Kg egg	0.32^{a}	0.30^{a}	0.25^{b}	0.29^{a}	0.26^{b}	0.31^{a}	0.26^{b}	0.12	*
Cost/Kg feed (א)	41.12^{a}	45.79^{b}	45.89^{b}	45.94^{b}	42.47^{c}	4257^{c}	42.67^{c}	0.48	*
Feed cost/bird/wk (א)	41.75^{a}	36.63^{c}	39.83^{b}	36.77^{c}	34.95^{d}	34.40^{d}	34.83^{d}	0.48	*
Cost of feed/egg (א)	6.96^{ab}	6.54^{b}	7.90^{b}	6.57^{b}	6.96ab	6.08^{c}	6.65^{b}	0.05	*

abc, Means within a row with different superscripts are statistically(P < 0.05) different.

Table 3: Egg quality of Laying Pullets Fed Experimental Diets

PKC Level Parameter	0% T1	20% T2	20% T3	20% T4	40% T5	40% T6	40% T7	SEM
Egg weight(g)	58.10	57.67	56.25	56.86	56.63	57.05	57.25	0.65
Haugh unit	72.67^{bc}	75.05^{ab}	74.24^{b}	76.57^{a}	76.28^{a}	76.68^{a}	75.52^{a}	0.67
Yolk weight(g)	17.91	16.78	17.09	17.03	16.85	17.33	17.28	0.39
Yolk index	0.30	0.30	0.30	0.31	0.31	0.31	0.31	0.06
Yolk colour	5.40	5.20	5.07	5.73	5.53	5.20	5.60	0.22
Albumen weight(g)	33.37	32.86	31.75	32.00	32.50	33.27	32.83	0.59
Albumen height(mm)	5.40	5.68	5.51	5.84	5.79	5.87	5.68	0.29
Egg shell weight(g)	5.93	5.99	5.87	5.95	5.90	5.93	5.92	0.13
Egg shell thickness(mm)	0.34	0.35	0.35	0.34	0.35	0.35	0.36	0.25
Shell surface area(SSA)	70.15	69.80	68.65	69.15	68.95	69.30	69.45	0.59
Egg shape index	0.71	0.70	0.70	0.71	0.70	0.69	0.70	0.07

abc, Means within a row with different superscripts are significantly(P< 0.05) different.

with increased inclusion level of PKC even with enzyme supplementation. The cost of feed per egg also appeared to decrease with increased inclusion of PKC in the diet although there were some exceptions. The cost of feed per egg was lowest (P < 0.05) for treatment 6(T6). In spite of the exceptions, the results are generally indications of possible gains realization for farmers with the use of PKC in the diets of pullets even at 40% inclusion level when supplemented with enzyme. Sundu *et al* (2005) had attributed low performance of birds fed PKC diets to imbalance of amino acids especially methionine and lysine. Although these amino acids are low in PKC, the most important factor affecting nutrient utilization in PKC is that high proportion of its nitrogen or protein is located inside the cell wall. Thus, the application of enzyme in this study falls within the two possible ways suggested by Sundu *et al.* (2005) for coping with the problems of PKC in feed formulation.

The results of the egg quality characteristics are presented in Table 3. All the external and internal egg qualities considered were not significantly (P > 0.05) affected by the dietary treatments with the exception of the Haugh unit. The Haugh unit was significantly ($P < 0.05$) improved with increase inclusion level of PKC in the diets. This also tends to increase with increased enzyme supplementation rate at the two levels of PKC inclusion considered. The non-significant mean values obtained for almost all egg quality parameters in the treatments implied that nutrients were similarly and effectively utilized from all diets. This may have been realised by the application of enzyme to the PKC diets which compared favourably with the control diet. More so, the higher Haugh unit values obtained for the PKC-enzyme supplemented diets is an indication of better protein utilization as haugh unit is an index of protein utilization. High haugh unit is also an indication of the quality of the egg. The sustenance of body weight which even slightly appreciated comparably in all dietary treatments is a corrobotion of good nutrient utilization in all the diets. Thus, the use of PKC at the 20 and 40% inclusion levels as a replacement for maize in laying birds diet did not adversely affect their performances and the egg qualities appeared to be slightly improved with PKC diets. The application of enzyme may have led to the realization of these results. However, apart from Haugh unit, the effect of increasing the rate of enzyme supplementation is not properly defined as to whether higher supplementation rate will contribute to better performance. Nevertheless the experiment thus supports the use of enzyme in supplementing PKC diets and this can encourage PKC inclusion level up to 40%. Perhaps a better way of applying the enzyme to the PKC rather than incorporation to the whole diet may enhance the utilization of PKC nutrients to achieve a better result

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