GROWTH PERFORMANCE AND COST-BENEFIT ANALYSIS OF GROWING PULLETS FED VARYING INCLUSION LEVELS OF PALM KERNEL CAKE

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ABSTRACT
The effect of feeding varying inclusion levels of palm kernel cake (PKC) on the growth performance and cost-benefit analysis of growing pullets was determined in a nine week study. Ninety six 11-weeks old pullets (Golden nestlink strain) averaging 710.00±10.86 g bodyweight (BW) were randomly assigned to 4 treatment groups (T1-T4), replicated twice with 12 birds per replicate in a completely randomized design (CRD). Each group was allotted to four diets having graded levels of PKC thus: T1=0 % PKC 100 kg^{-1} diet, T2=5 % PKC 100 kg^{-1} diet, T3= 10 % PKC 100 kg^{-1} diet and T4=15 % PKC 100 kg^{-1} diet. Feed and water were supplied *ad libitum.* Results showed that the effect of diets on final BW, BW gain, feed intake, feed conversion ratio and feed cost per kg gain were significant ($p<0.05$). Average daily weight gain of 12.38±0.07 g observed in birds of T4 was significantly different ($p<0.05$) from values of 8.41±0.04 g, 9.20±0.02 g and 11.26±0.05 g recorded for birds in T1, T2 and T3 respectively. Birds on treatment T4 (15 % PKC) had superior feed cost per kg gain of ₦ 348.19±9.86 which differed significantly ($p<0.05$) from ₦ 389.06±11.02, ₦ 489.22±8.72 and ₦ 456.10±10.11 observed in T3, T2 and T1 respectively. It was also observed that feed intake, weight gain alongside cost differential values of treatment diets increased as dietary PKC levels increased from 0-15 % 100 kg^{-1}. It was thus concluded that growing pullets can cost-effectively tolerate up to 15 % PKC in their diets without compromising performance.

Keywords: Animal protein, cost-effective feedstuff, nutrition, PKC, pullet chickens

INTRODUCTION
Egg production enterprise plays a key role in improving animal protein intake in developing nations of the world, where the average populace earns about $ 1 per day (FAO, 2010). Hence, raising good laying flock to supply the ample eggs needed to meet the recommended consumption of essential amino acids per caput is necessary (Oluyemi and Roberts, 2000). Several feedstuffs have been used to improve the performance of laying birds in a farm production cycle but with extra cost. Since feeding amounts to approximately 70% of production cost in a farm enterprise, a feedstuff that cost-effectively guarantees quality performance of animals should be well-preferred by local farmers. Palm kernel cake (PKC) is a by-product of hydraulic press oil extraction of the endosperm of oil palm fruit (*Elaeis guineensis*) (Afolabi *et al.,* 2008), which have been used in poultry nutrition as feedstuff to optimize their growth and general performance (Ugwu *et al*., 2008; Ezieshi and Olomu, 2004). It has been reported by Sundu *et al.* (2006) to be cheap, readily available and aflatoxin free with appreciable potential as carbohydrate and protein sources (Mustafa *et al.,* 2004). The tolerance of PKC by the gastrointestinal tract (GIT) of poultry has been disputed due to the inability of the birds' body to manage and utilize the amount of fibre characteristic of PKC (Sharmila *et al.,* 2014). Hence, the study evaluated the performance of growing pullets fed varying dietary inclusion levels of PKC, paying close attention to their growth and the cost-benefit analysis of the feeding.

MATERIALS AND METHODS
Location, duration and ethical clearance of the study
The study was conducted at the poultry unit of the Department of Animal Science Teaching and Research Farm, University of Nigeria, Nsukka. Nsukka is bound geographically within latitude 6^{o} $51^{'}$ $28.2^{''}$ N and longitude 7^{o} $23^{'}$ $44.8^{''}$ E and on the altitude 447 m above sea level (Obioha, 1992). The climate of the study area is typically tropical, with relative humidity ranging from 65-80 % and mean daily temperature of 26.8 ^{o}C (Agbagha *et al.,* 2000). The study lasted for nine (9) weeks during which the provisions of the Ethical Committee on the Use of Animals and Humans for Biomedical Research, University of Nigeria Nsukka were ardently adhered to.

Experimental material and diets

PKC was considered as the test ingredient and used alongside other feed ingredients to formulate the experimental diets. PKC was included at different inclusion levels of 0, 5, 10 and 15 % 100 kg^{-1} diet and assigned to the four treatment groups labeled T1-T4 respectively. The percentage composition of the experimental diets was presented in Table 1.

Table 1: Percentage composition of experimental diets

Ingredients	T1	T2	T3	T4
Maize	34.00	32.00	30.00	30.00
Soy bean meal	6.00	7.00	6.00	5.00
Wheat offal	56.00	52.00	50.00	46.00
Palm kernel cake	-	5.00	10.00	15.00
Bone meal	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Vitamin premix*	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Calculated composition				
Crude protein (%)	15.62	16.09	16.00	15.77
Crude fibre (%)	5.83	6.12	6.44	6.64
Energy (Mcal kg^{-1} ME)	2.38	2.37	2.34	2.35
Cost/tonne (₦)	59705	58385	55825	53905

*****Each 2.5kg of Starter premix contains: vit. A, 10000000 IU; vit. D3, 2000000 IU; vit. E, 23000 mg; vit. K3, 2000mg; vit. B1, 1800mg; vit. B2, 5500mg; Niacin, 27500mg; pantothenic acid, 7500mg; vit. B6, 3000mg; vit. B12, 15mg; folic acid, 750mg; biotin H2, 60mg; choline chloride, 300000mg; cobalt, 200mg; copper, 3000mg; iodine, 1000mg; iron, 20000mg; manganese, 40000mg; selenium, 200mg; zinc, 30000mg; antioxidant, 1250mg. T1=0 % palm kernel cake 100 kg^{-1} diet; T2=5 % palm kernel cake 100 kg^{-1} diet; T3=10 % palm kernel cake 100 kg^{-1} diet; T4=15 % palm kernel cake 100 kg^{-1} diet

Management of experimental birds

Ninety six 11-weeks old pullets (Golden nest-link strain) averaging 0.71±0.01 kg body weight were randomly divided into 4 treatment groups (T1-T4), replicated twice with 12 birds per replicate in a completely randomized design (CRD). The birds were placed in a double sided flat deck laying cages with an area of 2 m x 2 m. Feed and water were supplied *ad libitum*. The birds were fed for 7 days prior to data collection to get them stabilized on the test diet. Routine vaccination and prophylactic treatments were administered to the flock during the study. Records on feed intake and body weight gain were properly documented. All measurements were taken between 8.00 am and 12.00 pm.

Statistical analyses

Data collected were subjected to one way analysis of variance (ANOVA) for a CRD using a Statistical Analysis System (SAS, 2006). Significantly different means were separated using Duncan's New Multiple Range Test as outlined by Obi (2002).

RESULTS AND DISCUSSION

Growth performance of growing pullets fed varying inclusion levels of palm kernel cake

Table 2 shows the growth performance of growing pullets fed varying inclusion levels of palm kernel cake. The result showed that the effect of the test diets on the final bodyweight, average daily gain, average daily feed intake, feed conversion ratio and feed cost/kg gain were statistically significant ($p<0.05$). There was a significant increase in final body weight of the birds as the level of PKC in the diet increased. Birds on the highest level of PKC inclusion (T4) had significantly ($p<0.05$) higher body weight of 1490.00±20.06 g which differed from the 1240.00±22.10, 1300.00±18.92 and 1410.00±26.15 g recorded for birds on T1 (0 %), T2 (5 %), and T3 (10 %) respectively. The same trend of result was observed for average daily gain of the birds. Birds on T4 (15 %) had significantly ($p<0.05$) higher daily gain value of 12.38±0.07 g which differed from 8.41±0.04, 9.20±0.02 and 11.26±0.05 g recorded for birds on T1 (0 %), T2 (5%) and T3 (10%) respectively. This increase in body weight might be due to the crude fibre content of the PKC which optimized feed intake to meet the nutritional requirements of the birds. This intake of nutrients ultimately resulted in higher weight gains in the birds across the treatment groups. The result of this present study disagrees with the

findings of Ezieshi and Olomu (2004) who observed decreased weight gain when PKC was used to replace up to 30 or 43.75% of the maize fraction of the control diet. The observed difference may be attributed to the higher levels of PKC in their experimental diet. There was also significant increase in average daily feed intake. It was observed that as the level of PKC inclusion increased from 0 %-15 %, feed intake also increased. Thus, birds on the highest inclusion level (T4) had a feed intake value of 80.00±6.90 g which differed significantly ($p<0.05$) from 64.29±5.91, 77.14±4.88 and 78.51±7.28 g recorded for birds on T1, T2 and T3 respectively. This noted increase in the birds' feed intake may be due to the nature of their diet. Soltan (2009) and Ugwu *et al.* (2008) had earlier reported that increased dietary fibre increases feed intake. There is literature evidence that dietary fibre causes a dilution of the energy content of the ration, causing birds to consume more feed in an attempt to satisfy their energy requirement (Sundu *et al.*, 2006; Onifade, 1993). This may have been the reason for the increased feed intake with increasing PKC levels observed in this study. However, Zanu *et al.* (2012) recorded conflicting results as they documented a decrease in feed consumption of laying birds as levels of PKC increased to 15 kg 100 kg^{-1} diet. The authors linked the reduced feed intake to the high fibre content of the PKC diets used in their study. Nevertheless, a marked decrease was observed in the cost of diet kg^{-1} as the inclusion level of PKC increased. Birds on T4 had superior feed cost per kg gain of ₦ 348.19±9.86 which differed significantly ($p<0.05$) from ₦ 456.10±10.11, ₦ 489.22±22 and ₦ 389.06±11.02 observed for birds on T1, T2 and T3 respectively. The reduction in cost could be attributed to the increasing levels of PKC used. This result is in tandem with the reports of Ugwu *et al.* (2008) and Amata (2014) who asserted that non-conventional feedstuff resulted in lower composition cost thereby resulting in higher economic returns.

Table 2: Growth performance of growing pullets fed graded levels of palm kernel cake

Parameters	T1	T2	T3	T4	SEM
IBW (g $bird^{-1}$)	710.00±12.00	720.00±9.76	700.00±11.32	710.00±10.34	0.00
FBW (g $bird^{-1}$)	1240.00^{d}±22.10	1300.00^{c}±18.92	1410.00^{b}±26.15	1490.00^{a}±20.06	40.00
ADWG (g $bird^{-1}$)	8.41^{d}±0.04	9.20^{c}±0.02	11.26^{b}±0.05	12.38^{a}±0.07	0.04
ADFI (g $bird^{-1}$)	64.29^{d}±5.91	77.14^{c}±4.88	78.51^{b}±7.28	80.00^{a}±6.90	0.17
Feed conversion ratio	7.64^{c}±0.08	8.38^{d}±0.01	6.97^{b}±0.04	6.46^{a}±0.00	0.31
Feed cost/kg gain (₦)	456.10^{b}±10.11	489.22^{a}±8.72	389.06^{c}±11.02	348.19^{d}±9.86	23.94

^{abc}=Means on the same row with different superscripts are significantly ($p<0.05$) different; SEM=standard error of mean; IBW=initial bodyweight; FBW=final bodyweight; ADWG=average daily weight gain; ADFI=average daily feed intake; T1=0 % palm kernel cake 100 kg^{-1} diet; T2=5 % palm kernel cake 100 kg^{-1} diet; T3=10 % palm kernel cake 100 kg^{-1} diet; T4=15 % palm kernel cake 100 kg^{-1} diet

Cost-benefit of feeding graded levels of palm kernel cake to growing pullets

Table 3 shows the cost-benefit of feeding varying dietary inclusion levels of PKC to growing pullets. T4 had the least cost/kg diet of ₦ 53.90 which differed from ₦ 59.70, ₦ 58.38 and ₦55.82 values obtained from T1, T2 and T3 respectively. The cost difference indicates that the diet of T4 was the most cost effective having a differential of ₦ 5800 $tonne^{-1}$, better than T3 and T2 having ₦ 3880 ton^{-1} and ₦ 1320 $tonne^{-1}$ respectively.

Table 3: Cost benefit of feeding varying dietary inclusion levels of palm kernel cake to growing pullets

Parameters	T1	T2	T3	T4
Cost kg^{-1} diet (₦)	59.70	58.38	55.82	53.90
Cost 100 kg^{-1} diet (₦)	5970.50	5838.50	5582.50	5390.50
Cost $tonne^{-1}$ (₦)	59705.00	58385.00	55825.00	53905.00
Cost differential (₦)	–	1320.00	3880.00	5800.00

T1=0 % palm kernel cake 100 kg^{-1} diet; T2=5 % palm kernel cake 100 kg^{-1} diet; T3=10 % palm kernel cake 100 kg^{-1} diet; T4=15 % palm kernel cake 100 kg^{-1} diet

CONCLUSION

From the present study, PKC in the diets of pullets (5, 10 and 15 % 100 kg^{-1}) positively affected the performance of the birds by guaranteeing superior final body weights (1300.00^{c}±18.92, 1410.00^{b}±26.15 and 1490.00^{a}±20.06 g $bird^{-1}$ for T2, T3 and T4, respectively) and cost of feeding

(recording cost differentials of ₦ 1320.00, ₦ 3880.00 and ₦ 5800.00 tonne^{-1} for T2, T3 and T4, respectively). Hence, PKC should be encouraged in pullet nutrition within the inclusion levels used in the present study.

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