

## Growth performance and haematological characteristics of broiler finisher chickens fed palm kernel cake as partial replacement for maize and Soya bean

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### Abstract

High feed cost resulting from the use of conventional feed ingredients represents a major challenge in broiler production in South-East Nigeria. Feed constitutes 70% of the cost of production of broiler chickens hence, the replacement of unconventional feed ingredients holds the key to sustainable poultry production. This trial was aimed at determining the optimum inclusion level of palm kernel cake as a partial replacement of soya bean and maize in a broiler finisher diet during a 28-day trial. The PKC was included at 0%, 35%, 40% and 45% of total feed composition and birds were fed ad libitum. A total of one hundred and twenty (120) four week-old broilers were used for the measurements. Birds were allotted to four treatment groups of 10 birds each with three replications in a completely randomized design (CRD). The growth performance and haematological characteristics were evaluated. The results showed significant differences ( $P < 0.05$ ) in the final weight gains, average weight gain and feed conversion ratio but no significant differences was observed in the feed intake. The control diet had the highest average weight gain of 919.20g and 40% PKC inclusion had the least value of 595.47g. At end of the experiment, 6 birds randomly selected from each treatment were fasted overnight and slaughtered for blood samples collection. The results of the haematological parameters indicated significant differences ( $P < 0.05$ ) in the haemoglobin (Hb) concentrations, packed cell volume (PCV), total white blood cell counts (WBC), respectively. Furthermore, the mean cell volume (MCV), mean cell haemoglobin (MCH), mean cell haemoglobin concentration (MCHC) all showed significant variation. However, no significant differences were observed in the red blood cell count (RBC). From this study, it could be concluded that although broiler birds can tolerate high inclusion levels of PKC up to 40%, 35% was the level of inclusion that would result to higher weight gains for optimum productivity.

**Keywords:** Broiler chickens, growth performance, haematological characteristics, palm kernel cake

### Introduction

Broiler chickens provide a reliable source of high quality meat which is popular among majority of Nigeria's households. The ban on the importation of frozen poultry products in other to stimulate local production has led to increased smuggling of frozen poultry into the country which has

since divided industry experts on the efficiency of that policy. However, despite the prevalence of smuggled frozen poultry in the market, consumers have preference for locally produced chicken (Anyanwu *et al*, 2015). In addition, recent health concerns have led to preference for white meat over red meat. In Nigeria, the major

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ingredients for poultry feed production have been traditionally sourced from maize, soya bean cake, groundnut cake and fish meal. The pressure from the expanding human population has created competition by man and poultry for the same food ingredients leading to high rise in prices of conventional feed ingredients especially maize and soya bean, thereby increasing total feeding cost to between 60-80% especially for poultry and pigs (Ukachukwu, 2005). Therefore, the need for alternative feedstuff as major components of animal feed becomes imperative. A variety of alternative feed ingredient specific to certain agroecological zones could create comparative advantage in terms of price and availability thereby reducing production costs. Examples of some of these feedstuffs include cocoa pods, cassava peels, rice bran, wheat offals, brewers dried grain, cotton seed meal, groundnut cake, palm kernel meal and palm kernel cake. Palm kernel cake (PKC) is obtained by mechanical expeller, whilst palm kernel meal (PKM) is obtained from solvent extraction technique (Choct, 2001). Palm kernel cake is popular among small holder poultry producers especially in the south east of Nigeria where there is comparative advantage in its production. Previous studies on it have reported lower inclusion levels of 10 % (Soltan, 2009) due to high fibre, gritty nature and lower availability levels of amino acids, but Onwudike (1986) recommended inclusion levels of 28% and 35% whilst (Okeudo *et al.*, 2005; 2006) reported 30 % as the recommended inclusion level for finisher broilers. With some advancement in palm kernel processing which has improved quality in recent times, higher inclusion levels in finisher diets could further reduce the high cost of production, improve profit margins and increase sustainability of

production. Given the relatively lower cost of PKC in comparison to its alternatives, increasing its level of inclusion in broiler finisher diets would supply protein and energy due to its high metabolisable energy and protein content. More so, Panigrahi and Powell (1991) had shown that with methionine and lysine supplementation, broilers can be fed diets containing 40% PKC. Previous research had focused on growth rate, carcass characteristics, organoleptic test and feed cost benefit analysis, however research on higher levels of inclusion (up to 45%) and haematological properties has not been reported extensively. Based on the foregoing, this study was initiated.

### **Materials and methods**

#### ***Experimental site***

This research study was carried out at the Poultry Unit of Teaching and Research Farm, Federal University of Technology Owerri, located within latitudes N 5° 23' 33.6876", and longitude E 6° 59' 10.5504" in the south eastern part of Nigeria. The area experiences mean daily minimum temperature range of 19-24°C and maximum range of 28-35°C, average relative humidity of up to 80%, and a longer wet season which lasts from April-November. It has a tropical rain forest vegetation which has been affected by agriculture and other anthropogenic activities.

#### ***Preparation of experimental diets***

The palm kernel cake was purchased from a reputable commercial feedstuff dealer in Owerri, Imo state and was thoroughly mixed on the floor with other feed ingredients at the ratio of 35%, 40% and 45% of palm kernel of total feed in treatments II, III and IV respectively (Table 1).

**Table 1: Percentage composition of experimental diets**

Ingredients	PKC Levels %			
	0%	35%	40%	45%
Maize	58.00	44.00	40.00	35.00
Palm Kernel Cake (PKC)	0.00	35.00	40.00	45.00
SBM	15.00	4.00	4.00	3.00
Blood Meal	3.00	3.00	3.00	3.00
Fish Meal	2.00	2.00	2.00	2.00
Spent Grain	8.00	3.00	3.00	3.00
Wheat offal	10.00	5.00	4.00	5.00
Bone Meal	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25
Vitamin and Mineral premix	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
Total	100	100	100	100
<b>Calculated Energy and protein composition</b>				
Crude protein	19.52	17.27	17.60	17.72
ME Kcal kg <sup>-1</sup>	2,947.60	2832.75	2810.00	2760.15

### **Management of birds**

One hundred and twenty, four-week old unsexed broiler birds of B-knot hard strain were randomly distributed into four dietary treatment groups of thirty birds per group at the experimental pen. Each group was subdivided into three replicates of ten (10) birds each in a randomized complete block design. The birds had been previously floor brooded using electric bulbs and coal pots as sources of light and heat, vaccinated against Gumboro and New castle diseases and fed with commercial feeds, with water provided *ad libitum*, during the starter phase.

### **Collection of blood sample for haematological parameters**

Blood samples were collected from two birds per replicate, taken at the end of the finisher phase, for hematological studies. Twelve (12) birds were sacrificed and their blood collected from the jugular vein. The blood samples were collected in EDTA (ethylene diamine tetra acetic) anticoagulant treated bottles. Blood

samples were labeled according to the replicate and treatment pen. The EDTA bottles containing the blood samples were taken to a standard laboratory in Owerri, for hematological analysis.

### **Data collection**

Data on feed intake were taken daily while data on the weights were taken weekly. The following haematological parameters was taken on the collected blood samples; haemoglobin concentration (Hb), red blood cells (RBC), white blood cells (WBC), Neutrophils (Neut), basophils (Baso), lymphocytes (Lymph), eosinophils (Eos), haematocrit (haema.), mean corpuscular volume (MCV), monocytes (Mono.), white cell differential count (WCDC), packed cell volume (PCV) and mean corpuscular haemoglobin concentration (MCHC).

### **Statistical analysis**

Data on each of the parameters were subjected to analysis of variance (ANOVA) as a completely randomized design (CRD) according to the PROC GLM procedure of SAS 2002. The Duncan New Multiple

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Range test was used to determine differences between treatment means.

### **Results and discussion**

#### ***Growth performance***

The growth performance of the experimental birds in terms of their mean daily weight gain, daily feed intake, and feed conversion ratios for the various diets under study are shown in Table 2. The average feed intakes were 177.95, 183.82, 174.86, 163.76 g/day, for the control, 35% PKC, 40% PKC, 45% PKC diets respectively. There were no significant ( $P>0.05$ ) differences between the treatments with respect to this variable, so the inclusion of the PKC did not affect the bird's feed intakes. These results are consistent with the findings of Ezieshi and Olomu (2004) who did not observe any significant ( $P>0.05$ ) differences in feed intakes between broiler finishers fed 0%, 34%, and 44.95% PKC. Earlier studies by Onwudike (1986) did not record any significant ( $P>0.05$ ) variation in feed intake on feeds containing 0%, 11.67%, 23.33%, 35.00% and 46.67% and 58.33% PKC, also Okeudo *et al.* (2006) did not observe any significant variation ( $P>0.05$ ) at dietary inclusion of PKC for broiler finisher birds. This result indicates that inclusion of PKC in compounded broiler finisher rations have little or no effect on feed intake. The daily weight gain as observed in the data presented indicate a significant ( $P<0.05$ ) variation between the treatment with 0% PKC having the highest value of 32.83g than the other treatments. This could be explained by the slightly higher contents of crude protein and metabolisable energy of the control diet as compared to the test diets. The low-energy low-protein combination could have adversely affected the performance of the birds on the test diets which is in agreement with findings by Dairo *et al.* (2010). The reduction in weight gain also correlated

strongly with the findings of Soltan (2009). Reduction of body weight with increasing inclusion levels of P.K.C in broiler diets may be attributed to lower nutrient digestibility with PKC inclusion (Soltan, 2009), it could also be due to the high fiber content of PKC in the diet. Also, Sundu and Dingle (2003) reported that during the processing, PKC may undergo Maillard reaction (the reaction of mannose with amino groups leading to a formation of a brown complex) due to heat applied in the processing before and during oil extraction and this adversely affects digestibility. Also, Okeudo *et al.* (2006) reported that the final live weights of broilers fed the 0.0%, 15% and 30% PKC diets were similar (approximately 1.9 – 2.0 kg) and were significantly ( $P<0.05$ ) higher than the live weights of broilers fed 45% PKC diet (1.5 kg). The final live weights of birds from this trial are within range and consistent with those presented by Okeudo *et al.*, (2005). It is also in agreement with the result obtained by Panigrahi and Powell (1991) that 40% PKC in finisher broiler diets reduced weight gain but increased it when supplemented with lysine and methionine due to increased feed intake. The feed conversion ratios differed significantly between treatments ( $P<0.05$ ), as shown in Table 2 which suggests that increasing the proportion of PKC could reduce the feed conversion ratios of finisher broilers. The dip in the weight gain for the 40 % inclusion level could be as a result of the marginally lower content of crude protein compared to the 45% level of inclusion. This finding is inconsistent with the report by Odunsi *et al.* (2002) that the feed conversion ratio decreases as the proportion of fibre in the diet feed increases. However, other reports such as those produced by Dairo *et al.*, (2010) suggest that the feed conversion ratio can be increased by incorporating leaf meals if the quality of the dietary protein is increased by doing so.

**Table 2: Growth performance of broiler finisher chickens fed varying levels of PKC**

Parameter (g)	0%	35%	40%	45%	SEM
Initial weight	1185.7 <sup>a</sup>	1094.23 <sup>a</sup>	1089.43 <sup>a</sup>	1088.30 <sup>a</sup>	41.11*
Final weight	2341.30 <sup>a</sup>	1812.97 <sup>b</sup>	1684.90	1813.00 <sup>b</sup>	79.77*
Weight gain	1155.60 <sup>a</sup>	718.74 <sup>b</sup>	596.60 <sup>c</sup>	723.57 <sup>b</sup>	42.37*
Daily weight gain	32.83 <sup>a</sup>	25.67 <sup>b</sup>	21.27 <sup>b</sup>	23.97 <sup>b</sup>	1.51*
Daily feed intake	177.95	183.82	174.86	163.76	NS
Feed conversion ratio	2.13 <sup>a</sup>	2.83 <sup>b</sup>	2.90 <sup>b</sup>	2.52 <sup>b</sup>	0.054*

NS= No significant difference (P>0.05); \*= Significantly different (P<0.05) means along the horizontal rows with the same superscript are not statistically significant

The hematological indices of birds are shown in Table 3. The blood constituents are the biochemical medium of transport in all animals, thus their status shows the healthiness or otherwise of the birds. The normal physiological function of hemoglobin (Hb) and erythrocytes (RBCs) is to transport oxygen and carbon dioxide and from the present study, the hemoglobin (Hb) concentrations of the diets were as follows; 9.30, 8.78, 8.73, 7.53 g/dL, respectively. There were slightly significant (P<0.05) differences between the treatments groups, and the values obtained were within the range identified as optimal according to Mitruka and Rawnsley (1977), who identified Hb contents of 7-18g/dL as being normal in chickens. The range of values of PCV, Hb, and RBC contents of birds fed the various treatments is an indication of improved oxygen carrying capacity of the cells which translated to a better availability of nutrients to the birds consequently affecting their well-being. The packed cell volumes for the control group, the 35%, 40%, and 45% PKC diets, were 28.75, 27.00, 26.18, 24.00 respectively. There were significant (P<0.05) differences between the treatment groups with respect to the PCV. Packed cell volume values of 24.00-28.75 obtained from the present study is within the range of 22-35% reported by Bounous and Stedman (2000) and lower than the range of 30-33% reported by Duke *et al.*, (1993) as the PCV for chicken and turkeys. Also, the values

were similar to 24.7- 28.97 % reported by Uniugwe *et al.*, 2006 for broiler birds fed potato leaf meal. The values obtained for all the diets indicate nutritional adequacy of all diets since values did not indicate under-nutrition nor malnourishment. Hacbath *et al.* (1983) recorded a strong influence of diet on haematological traits; PCV and Hb being very strong indicators of nutritional status of animals. The RBC values were  $2.58 \times 10^5$ ,  $2.68 \times 10^5$ ,  $2.53 \times 10^5$  and  $2.13 \times 10^5$  respectively. The total RBC showed no significant differences (P>0.05) among the diets. Normal ranges of  $2.5-3.5 \times 10^5$  and  $2.5-3.2 \times 10^6/\text{mm}^3$  were respectively reported by Bounous and Stedman (2000) as well as Duke *et al.*, (1993). Hacbath *et al.* (1983) reported that increased RBC values were associated with high quality protein and disease-free animals. The white blood cell counts were  $1452.75 \times 10^3$ ,  $1612.75 \times 10^3$ ,  $1350 \times 10^3$ , and  $1253 \times 10^3$  for treatments 0%, 35% 40% and 45 % respectively. Although, the WBC values obtained for different treatment groups examined in this work differed significantly (P<0.05), the values obtained indicate that 35% inclusion of PKC was the optimum level that promoted the highest level of WBC, because beyond this level led to a reduction of WBC count. The gradual rise in WBC as the inclusion levels increased could suggest that PKC might have immune boosting properties up to a certain level in broilers. These results are supported by recent findings, (Sundu *et al.* 2006, Tafsin *et*

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*al.*, 2017) to the effect that the mannan containing polysaccharides in PKC play vital biological functions in enhancing immune response and to control pathogens in poultry. Also, Essiet and Isongesit (2013) reported that anti-feedants in the *Ocimum gratissimum* leaf meal and *Gongronema latifolium* leaf meals at higher levels of inclusion, were released into the blood streams of broiler birds and caused some level of systematic toxicity that reduced the birds PCV, RBC and WBC values. These results may indicate that the PKC - containing diets at 40% and 45% might mildly suppress the bird's hematopoietic tissues and thereby reduced WBC production and that PKC inclusion at 35% was the optimum level to increase the bird's immune system. Increased haematological parameters could be associated with high quality protein. In the same vein, Unigwe and Nwakpu (2009) demonstrated that increases in Hb, RBC and PCV due to increased mineral content of feed is an indispensable factor of erythropoiesis. These haematological parameters fall within the normal physiological ranges as established by Mitruka and Rawnsley (1977). The values of the mean cell volume (MCV), mean cell haemoglobin (MCH), mean cell haemoglobin concentration (MCHC) are shown in Table 3. The MCV were 115.93, 92.20, 104.30, 103.23 respectively, while the MCH values were 35.30, 31.28, 34.73, and 30.48 respectively. The MCHC values were 33.00, 33.13, 33.33 and 30.00 respectively,

indicating significant variation. Theoretically, an increase in the number of erythrocytes of the same volume (MCV) always leads to the increase in haematocrit value; hence the MCHC index should decline, assuming that the content of haemoglobin remains unchanged. Therefore, elevated content of haemoglobin should lead to the increase in MCHC, provided the number of erythrocytes and their volume (MCV), and hence haematocrit, do not change. An attempt at elucidating the results of this study can be a situation in which the increase in the number of erythrocytes (at constant MCV) and hence growth of haematocrit in chickens was higher than the increasing haemoglobin content. This continued to reduce MCHC. In other words, chickens that were characterized by greater numbers of red blood cells (and hence, higher haematocrit value) could have erythrocytes of lower haemoglobin content although it's amount in blood was higher. This phenomenon, in turn, can be explained in many different ways. It can be assumed that normally, these chickens produce more cells because they are perhaps characterized by a lower efficiency of incorporating haemoglobin into cells.

#### ***Eosinophil, basophil, monophile, and neutrophil,***

These counts all rise during allergic responses and are frequently associated with helminth infections. The counts of all these cell types were very low in the birds, suggesting that the diets may have anti-helminthic properties.

**Table 3: Haematological indices of broiler finisher chickens fed varying levels of PKC**

Parameter	T1	T2	T3	T4	SEM
Haemoglobin	9.30 <sup>a</sup>	8.78 <sup>a</sup>	8.73 <sup>a</sup>	7.53 <sup>b</sup>	0.225*
Packed cell volume	28.75 <sup>a</sup>	27.00 <sup>ab</sup>	26.18 <sup>b</sup>	24.00 <sup>c</sup>	0.648*
White blood count	1452.75 <sup>b</sup>	1612.75 <sup>a</sup>	1350 <sup>bc</sup>	1253 <sup>c</sup>	35.69*
Red blood count	2.58	2.68	2.53	2.13	0.277NS
Lymphocyte	80.50 <sup>b</sup>	90.00 <sup>a</sup>	80.25 <sup>b</sup>	86.75 <sup>a</sup>	1.154*
Neutrophil	18.25 <sup>a</sup>	7.75 <sup>c</sup>	10.50 <sup>bc</sup>	12.25 <sup>b</sup>	1.058*
Eosinophil	1.25 <sup>b</sup>	1.75 <sup>a</sup>	1.25 <sup>b</sup>	1.00 <sup>b</sup>	0.151*
Monophil	0.00	0.00	0.00	0.00	0.00
Basophil	0.00	0.00	0.00	0.00	0.00
Mean cell volume	115.93 <sup>a</sup>	92.20 <sup>c</sup>	104.30 <sup>b</sup>	103.23 <sup>b</sup>	2.382*
Mean cell haemoglobin	35.30 <sup>a</sup>	31.28 <sup>b</sup>	34.73 <sup>a</sup>	30.48 <sup>b</sup>	0.667*
Mean cell haemoglobin concentration	33.00 <sup>a</sup>	33.13 <sup>a</sup>	33.33 <sup>a</sup>	30.00 <sup>b</sup>	0.638*

NS= No significant difference (P>0.05); \*= Significantly different (P<0.05) (P<0.05) means along the horizontal rows with the same superscript are not statistically significant

### Conclusion and recommendations

From the result of the experiment carried out, the inclusion of palm kernel cake (PKC) at 35%, 40% and 45% did not show any significant differences (P>0.05) in the feed intake but rather significant differences were observed in the growth performance, with the control diet having a higher daily weight gain value of 32.83g and 40% PKC having the least value of 21.27 g. The haematological indices showed that increasing the PKC beyond 35% resulted in a reduction in the WBC showing that the PKC can increase the birds immune system at moderate amount of inclusion. In addition, the partial replacement of maize and soyabean by PKC in this study may have reduced cost, although this was outside the scope of the present study. Therefore, the inclusion of PKC meal at 35%, 40% and 45% in broiler finisher diet would not have any deleterious effect on the birds performance as long as the feed is balanced with other feed ingredients such as the essential amino acids lysine and methionine. Furthermore, inclusion of enzyme supplementation at higher levels of PKC in the diet may be considered. In this era of exorbitant feed costs, the use of PKC might be the alternative small scale farmers are really searching for. Already, some farmers use

measured quantities of PKC to mix purchased commercial feeds in order to increase the quantity of feed. Although this practice is not recommended without proper analysis of the calculated contents of protein and metabolisable energy, some farmers see it as a temporary solution to the problem.

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