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Growth Performance and Internal Organs of Broiler Chickens Fed Diets Containing Unripe Plantain Peels Meal

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Abstract
This study was conducted to determine the dietary effect of graded levels of unripe plantain peel meal on the growth performance and internal organs of broiler chickens. One hundred and five (105) day-old unsexed Arbor Acre broiler chicks were used in a56-day feeding trial. The birds were assigned to 5 dietary treatments (T1- T5) with a total of 21 birds per treatment and replicated three times with 7 birds per replicate in a completely randomized design (CRD). T1 was the control diet which contained 0% unripe plantain peels and 100% palm kernel cake, T2 contained 25% unripe plantain peels and 75% palm kernel cake, T3 contained 50% unripe plantain peels and 50% palm kernel cake, T4 contained 75% unripe plantain peels and 25% palm kernel cake while T5 contained 100% unripe plantain peelsand 0% palm kernel cake. Feed and water were given *ad libitum* for 8 weeks the experiment lasted.Resultsshowed that at the starter phase diets had a significant ($P<0.05$) effect on live weight, daily weight gain, and daily feed intake. During the finisher phase replacement of palm kernel cake with unripe plantain peels hadno significant ($P>0.05$) effect on daily protein intake, protein efficiency ratio and feed conversion. The performance of birds at both the starter and finisher phases decreased as the level of unripe plantain peel meal (UPPM) increased. Unripe plantain peels did not show negative effect on the liver, bile volume and the caecum but all other parameters for internal organs were significantly ($p<0.05$) affected by the diet. In conclusion, unripe plantain peel meal (UPPM) could conveniently replace 25% of Palm kernel cake in the diet of broiler chickens without any deleterious effect and is recommended.
Keywords: Unripe plantain peels, Broiler Chicken, Palm Kernel Cake, Internal organs, Growth Performance
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1. Introduction

Poultry production, because of its short gestation and generation interval, large number, fast growth rate, greater affordability, and ease of rearing (Ibe, 2004), has the capacity to close the existing gap in animal protein consumption in the country (Ugwu*et al*., 2008). However, the industry in developing countries is facing some challenges, these challenges include high feed to gain ratio, and increase in the cost of feed because of high prices of feed ingredients (Anandakumar*et al.,* 2013).

The core feed ingredients; maize, soybean meal and fish meal which are cost intensive must be used in such a way to check cost and also not reduce the quality of the feed. To achieve these, some agro-industrial by-products could be used in feed formulation. One of the major agro-industrial by-products inclusion is palm kernel cake (PKC). The use of palm kernel cake in broiler diets has been a known practice for several decades. This is because it has a medium grade protein (Chin, 2001), nevertheless, there are challenges in the PKC as part of feed ingredients, some of these challenges include, low level of key essential amino acids -Lysine and Methionine in particular (Chin, 2002), lack of some bioactive substances (carotenoids), and it is particularly high in non-starch polysaccharides (Mannan) as well its grittiness which limits feed digestibility and usage. In a bid to mitigate these challenges unripe plantain peels, an agro by-products was considered as a replacement to PKC. The plantain peels are regarded as wastes mostly in urban areas where there are no much roaming ruminants (Goat, Sheep, etc.) which could actually feed on them.

The use of this plantain peels (unripe) would also help to reduce the environmental pollution caused by the peels and also could serve as a good replacement for PKC. The proximate composition of unripe plantain peel contained 6.89% crude protein, 7.47% moisture, 17.59% ash, 16.20% crude fiber, 3,67% crude fat, and 48.18% carbohydrate, which makes it a good source of dietary fibre, protein and carbohydrate for broiler rations (Ighodaro, 2012). Plantain peels (unripe) have high anti-oxidant efficiency, high level of mineral especially calcium and phosphorus, presence of bio-active compounds (carotenoids) and high level of amino acids which made it to be considered as an alternative to palm kernel meal (Akinsanmi *et al.,* 2015).The objective of this study was to determine the effect of unripe plantain peels as a replacement for palm kernel cake on performance of broiler chickens.

2. MATERIALS AND METHODS

2.1 Experimental Site

The study was carried out at the Poultry Unit of Teaching and Research Farm of the University of Uyo, AkwaIbom State, Nigeria.Uyo is located between latitude $4^{0}57'$ N and longitude $7^{0}53'$E with average annual rainfall of 2,190mm. The average relative humidity during the experimental period was 81%.

2.2 Unripe Plantain Peels Collection, Processing and Diet Preparation

The unripe plantain peels were collected from different women selling "bole" (roasted plantain) at different locations within Uyo metropolis. The peels from the plantain were sun dried for 10-15 days in batches to reduce the moisture content. After sun drying, the dried unripe plantain peels were milled with a hammer mill and the ground plantain peels were packaged in airtight bags and stored at room temperature which was incorporated into the starter and finisher diets (Tables 1 & 2).

Table 1:*Ingredient and nutrient composition of experimental diets with unripe plantain peel meal fed to broiler starter chickens*

Treatments	**T1**	**T2**	**T3**	**T4**	**T5**
% Replacement of PKC with UPPM	0	25	50	75	100
Ingredients (%):					
Maize	51.00	51.00	51.00	51.00	51.00
SBM	30.00	30.00	30.00	30.00	30.00
UPPM	0.00	2.55	5.10	7.65	10.20
PKC	10.20	7.65	5.10	2.55	0.00
Fish meal	4.00	4.00	4.00	4.00	4.00
Bone meal	4.00	4.00	4.00	4.00	4.00
Salt	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.10	0.10	0.10	0.10	0.10
Premix*	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated Nutrient Composition (%)					
ME (Kcal/kg DM)	2904	2873	2842	2812	2781
Crude protein	22.84	22.78	22.72	22.67	22.61
Ether Extract	3.88	3.85	3.81	3.77	3.74
Crude fibre	4.23	4.33	4.43	4.53	4.63

**Premix supplied per Kg starter diet: vitamin A 15,000 i.u., vitamin D3 13,000 i.u., thiamine 2mg, riboflavin 6mg, pyridoxine 4mg, cobalamin 0.05g, biotin 0.08mg, choline chloride 0.05g, manganese 0.096g, iron 0.024g, copper 0.006g, iodine 0.014g, selenium 0.24mg, cobalt 0.024mg and antioxidant 0.125g*

SBM = Soybean Meal, UPPM = Unripe Plantain Peel Meal, PKC = Palm Kernel Cake

Table 2: *Ingredient and nutrient composition of experimental diets with unripe plantain peel meal fed to broiler finisher chickens*

Treatments	**T1**	**T2**	**T3**	**T4**	**T5**
% Replacement of PKC with UPPM	**0**	**25**	**50**	**75**	**100**
Ingredients (%):					
Maize	51.00	51.00	51.00	51.00	51.00
SBM	28.00	28.00	28.00	28.00	28.00
UPPM	0.00	3.80	7.60	11.40	15.20
PKC	15.20	11.40	7.60	3.80	0.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
Premix*	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated Nutrient Composition (%)					
ME (Kcal/kg DM)	2926	2880	2834	2789	2743
Crude protein	21.64	21.55	21.47	21.38	21.30
Ether Extract	4.02	3.96	3.92	3.86	3.80
Crude fibre	4.68	4.83	4.98	5.13	5.27

**Premix supplied per Kg finisher diet: vitamin A 10,000 i.u., vitamin D3 12,000 i.u., vitamin E 20 i.u., vitamin K 2.5mg, thiamine 2.0mg, riboflavin 3.0 mg, pyridoxine 4.0mg, niacin 20mg, cobalamin 0.05mg, pantothenic acid 5.0mg, folic acid 0.5mg, biotin 0.08mg, choline chloride 0.2mg, manganese 0.006g, zinc 0.03g, copper 0.006g, iodine0.0014g, selenium 0.24g, cobalt 0.25g and antioxidant 0.12*

2.3 ExperimentalTreatment and design

One hundred and five (105) unsexed day-old Arbor Acre broiler chicks were procured from a reputable dealer in Uyo. The birds were weighed at the beginning of the experiment using a sensitive weighing balance to obtain the initial weight. The birds were managed in deep litter pens during the brooding and the rearing phases, wood shavings served as the litter material The birds were allotted to five dietary treatments (T1, T2, T3, T4 and T5) each having 21 birds and replicated three times with 7 birds per replicate in a completely randomized design (CRD).T1 was the control diet which contained 0% unripe plantain peels and 100% palm kernel cake, T2 contained 25% unripe plantain peels and 75% palm kernel cake, T3 contained 50% unripe plantain peels and 50% palm kernel cake, T4 contained 75% unripe plantain peels and 25% palm kernel cake while T5 contained 100% unripe plantain peelsand 0% palm kernel cake.The experiment lasted for 56 days. Feed and water were given *ad libitum*.

2.4 Data Collection and Statistical Analysis

The daily feed intake was recorded at the end of the week and average daily feed intake was calculated. Weekly live body weight was measured and average daily live weight calculated. These values were used to obtain the feed intake per bird per day, total weight gain, weight gain per bird per day and feed to gain ratio.

At the end of the experiment, three birds with average mean weight from each of the treatment were slaughtered, immersed in hot water (60^{o}C) for 30 seconds their feathers were plucked and their abdomen were opened and their internal organs removed and thereafter were cut into different cut parts. Each internal organ and the cut parts were weighed and the cuts parts weight expressed as percentage of their dressed weight while internal organs were expressed as percentage of live body weight.

Data collected were subjected to Analysis of Variance (ANOVA) using SPSS software and significant means were separated using Duncan's New Multiple Range Test, (Ducan, 1955) as described by (Steel and Torrie, 1980).

3. Results

The dietary effect of graded levels of unripe plantain peels as a replacement for palm kernel cake on growth performance of starter chicks is presented in Table 3. The unripe plantain peels significantly($P<0.05$ affected the final live weight, dailyweight gain, total feed intake and daily feed intake while the daily protein intake, protein efficiency ratio, and feed conversion ratio were not significantly ($P>0.05$)affected as the control group recorded the highest mean values As the level of inclusion of plantain peels in the starter diet increased, final live weight, daily weight gain, ad daily feed intake decreased as birds that consumed 100% unripe plantain peel meal

recorded the least in all the parameters as compared to the control.Feed ratio was poorest in group of birds that consumed unripe plantain peels compared to the control. Protein intake and protein efficiency ratio followed similar trend as the feed to gain ratio.

Table 3 : *Effect of dietary levels of unripe plantain peel meal on growth performance of starter broiler chickens*

Treatments	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**
% Replacement of PKC with UPPM	0	25	50	75	100	
Parameters:						
Initial weight (g)	42.69	40.00	42.00	42.50	40.00	1.15 Ns
Final live weight (g)	756.67^{a}	704.68^{ab}	670.64^{ab}	581.43^{b}	565.86^{b}	46.45
Daily weight gain (g)	25.50^{a}	23.74^{ab}	22.45^{ab}	19.24^{b}	18.78^{b}	1.66
Total feed intake(g)	1672.72 a	1574.44ab	1527.96ab	1525.72ab	1403.36b	64.45
Daily feed intake(g)	59.74^{a}	56.23^{b}	54.57^{b}	54.49^{b}	50.12^{b}	1.83
Daily protein intake(g)	14.29	13.80	13.60	13.06	11.95	0.69 Ns
Protein Efficiency Ratio	1.78	1.74	1.65	1.47	1.57	0.14 Ns
Feed: gain ratio	2.34	2.37	2.43	2.83	2.62	0.19 Ns

$^{a-c}$Means along the same row with different superscripts are significantly different ($p<0.05$)

The dietary effect of unripe plantain peel meal on finisher broilers is shown inTable 4. At that stage of production diet had significant ($P<0.05$) influenced on all the growth parameters measured except protein intake, protein efficiency ratio and feed gain ratio.Both the final live weight and daily weight gain, were negatively affected by addition of unripe plantain peel meal up to 100% in the diet. Total feed intake and daily feed intake of the birds were significantly ($P<0.05$) reduced on addition of unripe plantain peel meal up to 100% level as compared to the control. Inclusion of unripe plantain peel meal in the diet of finisher broilers had no significant ($p>.0.05$) effect on protein intake and protein efficiency ratio. The quantity of protein consumed daily was higher in the control group than those consumed unripe plantain peel meal. The feed gain ratio was poorest in birds that consumed unripe plantain peel meal up to 100% level compared to the control. The control group had better feed gain ratio than the groups. However, it was observed that protein utilization was better in groups that were fed 50% unripe plantain peel meal compared to the control.

Table 4: *Effect of dietary levels of unripe plantain peel meal on growth performance of finisher broiler chickens*

Treatments	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**
% Replacement of PKC with UPPM	0	25	50	75	100	
Parameters:						
Initial body weight (g)	756.67^{a}	704.68^{ab}	670.64^{ab}	581.43^{b}	565.86^{b}	46.45
Final body live weight (g)	2090.50^{a}	1990.20^{b}	1819.10^{b}	1696.20^{c}	1666.70^{c}	132.06
Daily body weight gain (g)	47.64^{a}	45.91^{ab}	41.02^{ab}	39.81^{bc}	39.32^{bc}	4.65
Total feed intake (g)	3477.32a	3392.48a	3247.72b	3211.6b	3168.76b	80.77
Daily feed intake (g)	124.19^{a}	121.16^{a}	115.99^{b}	114.77^{b}	113.17^{b}	6.25
Daily Protein Intake (g)	30.45	28.34	24.65	24.26	23.87	2.12Ns
Protein Efficiency Ratio	1.56	1.62	1.66	1.64	1.65	0.16Ns
Feed: gain ratio	2.61	2.64	2.73	2.83	2.87	0.29Ns

$^{a-c}$Means along the same row with different superscripts are significantly different ($P<0.05$)

The effect of unripe plantain peel meal on internal organs of broiler chickens is indicated in Table 5. The dietary treatments significantly ($p<0.05$) influenced all the parameters measured for internal organs except in the percentage weight of the liver, bile volume and caecum which were not significantly ($p>0.05$). Control group recorded highest percentage weight lung, proventriculus, heart, kidney, pancreas, spleen, bile volume, small intestine, large intestine except for the liver. Feeding of unripe plantain peel meal up to 100% level of replacing PKC resulted to a smaller gizzard, kidney, spleen and largeintestine than the control group. The biggest gizzard was recorded by replacing 50% PKC with unripe plantain peel meal while the weight of the gizzard of other groups were significantly ($p>0.05$) similar to that of the control group. There was no difference between birds that were receiving up to 50% unripe plantain peel meal replacement and the control group in the bile volume, small intestine, spleen, kidney, and the large intestine.

Table 5: *Effect of dietary levels of unripe plantain peel meal on internal organs of broiler finisher chickens*

Treatments	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**
% Replacement of PKC with UPPM	**0**	**25**	**50**	**75**	**100**	
Parameters:						
Lungs	0.75^{a}	0.55^{b}	0.52^{b}	0.48^{b}	0.47^{b}	0.04
Proventriculus	0.56^{a}	0.54^{ab}	0.46^{ab}	0.42^{ab}	0.33^{b}	0.04
Gizzard	2.09^{ab}	2.13^{ab}	2.48^{a}	2.11^{ab}	1.89^{b}	0.12
Liver	1.91	2.04	2.09	2.13	2.29	0.12
Heart	0.49^{a}	0.43^{ab}	0.43^{ab}	0.39^{b}	0.45^{ab}	0.02
Kidney	0.56^{a}	0.54^{ab}	0.52^{ab}	0.46^{b}	0.23^{c}	0.02
Pancreas	0.26^{a}	0.25^{a}	0.20^{b}	0.20^{b}	0.19^{a}	0.01
Spleen	0.25^{a}	0.15^{b}	0.23^{a}	0.14^{bc}	0.12^{c}	0.01
Bile volume	0.07	0.04	0.05	0.03	0.04	0.01
Small intestine	4.47^{a}	3.57^{b}	4.07^{ab}	4.02^{ab}	3.63^{b}	0.18
Caecum	0.52	0.55	0.59	0.61	0.58	0.05
Large intestine	0.16^{a}	0.13^{a}	0.15^{a}	0.14	0.06^{b}	0.02

$^{a\text{-}c}$Means along the same row with different superscripts are significantly different ($p<0.05$)

4. DISCUSSION

Replacement of palm kernel cake with unripe plantain peel meal up to 100% level significantly reduced final live weight, daily weight gain, total feed intake and daily feed intake of birds during the starter phase of production. The negative effect could be attributed to high fibre content in the diet which is required in limited quantity in poultry diet as reported by(Uchegbu*et al.* 2010),), Also, according to (Makkar*et al*., 2009; Eleazu*et al*., 2010) the presence of anti-nutritional substances especially tannin may affect palatability, digestion and utilization of nutrients. The results from this study is in line with (Tewe, 1983) and, (Uwakala*et a*l.,2013), who reported that performance of broiler chickens declined progressively as the amount of unripe plantain peel meal increased beyond 37.50% in the diet. The results of feed: gain ratio, protein intake and protein efficiency ratio obviously indicate that poor growth performance of birds that consumed unripe plantain peel meal up to 100% replacement for PKC in the diet can beattributed to poor utilization of nutrients in the unripe plantain which create a gut fill sensation and subsequent depression of appetite, and lower protein content of UPPM as compared to palm kernel cake.

At the finisher stage, reduction of final live weight, daily weight gains and feed intake of birds as the levels of UPPM increasedup to 100% of PKC implies that the birds did not properly utilize the feeddue tohigh crude fibre, anti-nutritional contents, bulkiness, and semi powdery nature of unripe plantain peel meal which appears to be the major limiting factor in proper utilization in broiler diets. (Von Loesecke, 1990). Results showed that feed intake and weight gain of finisher birds at 25% inclusion of unripe plantain peel meal compared favourablywith the control diets. In contrast, (Uwakala*et a*l.,2013) reported that 37.50% level of incorporation appeared to be the optimal replacement level of UPPM in daily weight gain as performance were significantly depressed when levels of higher than 37.5% were included in the broiler diets. From the outcome of this work, the poorest feed: gain ratio was recorded for birds consuming 100% UPPM as replacement for PKC which was the highest and this indicate poor utilization of nutrients which resulted in lower weight gains of the birds. This in line with (Oyedeji*et al*., 2015)who observed that the lowest weights gain per bird and the worst feed: gain ratio were recorded when 100% of UPPM was replaced with maize.It could be suggested that 25% UPPM be fed during the finisher phase of production'

Feeding of UPPM in the diet did not impact negatively to enlarge the size of theLiver. The smallest gizzard and kidney was recorded for inclusion of UPPM up to 100% in the diet. This may be due to the semi powdery nature of the UPPM especially on the gizzard which did not contain enough feed that could lead to proper digestion in the duodenum thereby resulted to smaller size of large intestine which linked to low microbial load in the intestine of the animals. According to (Uwakala*et a*l.,2013) increasing the levels of UPPMto 37.5% improve crop, liver, spleen weights in broilers finishers. In contrast, feeding of UPPM up to 25% level of PKC replacement was safe and not detrimental to the important organs like the kidney, liver, heart and the spleen

5. CONCLUSION

Replacing 100% PKC with UPPM in broiler chickens diet adversely affected their live weight, weight gain, and feed intake. However, replacement of PKC by UPPM up to 25% level improved growth performance and the internal organs of the birds. Therefore, replacement of palm kernel cake with UPPM up to 25% in the diet of broiler chickens is recommended for optimum broiler performance.

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