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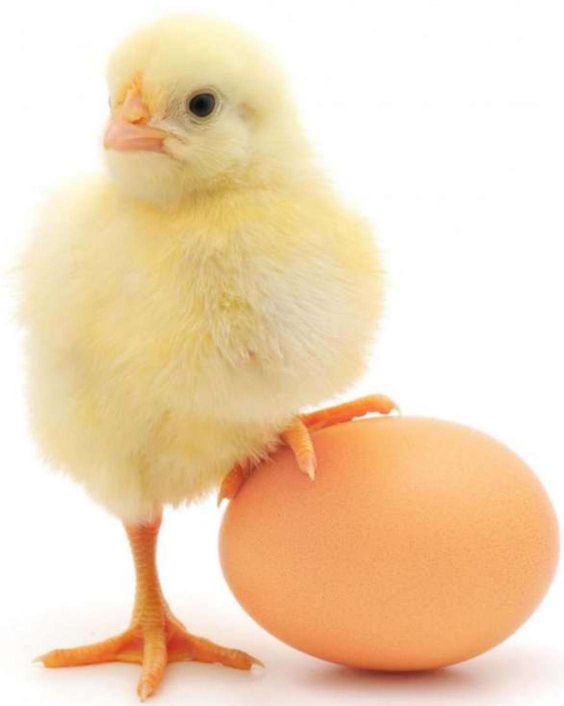

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Production Performance, Meat Quality and Feed Cost Implications of Utilizing High Levels of Palm Kernel Cake in Broiler Finisher Diets

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Abstract: Marshall broiler finishers were fed diets containing 0%, 15%, 30% and 45% palm kernel cake (PKC) from the 3rd till the 9th week of age. The effects of diet on growth rate, feed cost per unit live weight gain, carcass characteristics and organoleptic quality were determined. Diet-related differences in average daily feed intake were not significant ($P > 0.05$). The final live weights of broilers fed the 0%, 15% and 30% PKC diets were similar (approximately 1.9 - 2.0kg), and were significantly higher ($P < 0.05$) than the live weights of broilers reared on the 45% PKC diet (1.5 kg). Similarly, average daily live weight gain and feed conversion ratio were adversely affected by diet at the 45% PKC inclusion level ($P < 0.05$). However, feed costs per unit live weight gain were similar across the four experimental diets ($P > 0.05$). Effects of diet on carcass characteristics were limited to dressing percentage and percent head and gizzard contents ($P < 0.05$) and no significant differences were observed in meat tenderness, juiciness, flavour and hedonic scores ($P > 0.05$). It was concluded that up to the 45% inclusion level, feed intake and financial returns were not affected by the incorporation of PKC in broiler finisher diets.

Key words: Palm kernel cake, broiler, live weight, carcass characteristics, organoleptic quality

Introduction

The entrenchment of the utilization of palm kernel cake (PKC) in poultry feeding in Nigeria has been recognized as a major contributor to the survival of the local poultry industry in recent time. During the plenary discussion session at the 27th Annual Conference of the Nigerian Society of Animal Production (2002), stakeholders in the animal production sector concluded that commercial utilization of PKC in poultry diets provided the cheaper alternative when many poultry farms were closing down due to unbearably high production costs emanating from rapidly increasing feed cost. Partial or complete replacement of the conventional feedstuffs (such as maize and groundnut cake) in poultry diets would reduce the inflationary pressure on these feed ingredients, reduce their costs and increase their availability to the poor (Onwudike, 1986a). To the poultry farmer, the major attraction in the utilization of PKC is its relatively low cost. Presently, in South-Eastern Nigeria, the retail price for one kilogram of PKC is N7.00; maize, N48.00; wheat bran, N20.00; brewers' dried grain, N15.00; soyabean meal, N72.00; and fish meal, N190.00 (note, N = Nigerian Naira; 1 US $ = N128). Hence, the utilization of PKC has encouraged and sustained small scale producers (with small financial capabilities) which currently predominate in the Nigerian poultry industry. Utilization of PKC in animal diets is also a tremendous benefit to the economy as a whole. An abundant agro-industrial by-product, hitherto treated as a waste, has become a valuable resource and is significantly enhancing the total revenue derivable from the oil palm industry. In order to maximize the revenue obtainable from processing of palm kernels, demand for PKC must be maximized by the incorporation of PKC in animal diets at the highest and most profitable level. This level would be determined, not by the level of biological yield (meat products) only, but more importantly by derivable profitability as the major criterion. In this regard, the relationship between live-weight gain, and the associated feed cost is of paramount importance. Moreover, it is known that the cost of feeding represents 70%-80% of the total variable cost of poultry production in Nigeria (Durunna *et al.*, 1999; Olomu, 2003).

Palm kernel cake alone cannot constitute a complete diet for poultry, or any other animal. Relatively high levels of intake is hampered by the high fiber content, low digestibility, gritty nature and low availability levels of amino acids (Onwudike, 1986b; Hair- Bejo and Alimon, 1995). However, early reports indicated that PKC can be fed to starter and finisher broiler chicks at the 28% and 35% inclusion levels, without a deleterious effect on production (Onwudike, 1986b). Our previous report (Okeudo *et al.,* 2005) showed that broilers fed a 30% PKC diet during the finisher phase were similar in growth rate to counterparts fed a 0% PKC diet, whilst broilers fed diets containing PKC were higher in meat flavour. Panigrahi and Powell (1991) had shown that with methionine and lysine supplementation, broilers can be fed diets containing 40% PKC. Interestingly, recent findings have also demonstrated that inclusion of PKC in poultry diets improves the health and immunity of the birds (Allen *et al.,* 1997; Sundu *et al.,* 2006).

Table 1: Ingredient composition of starter and finisher diets

		Finisher diet (Palm kernel cake (%)			
Ingredient	Starter Diet	0	15	30	45
Maize	50.00	58.00	50.00	47.00	36.00
Palm Kernel cake	0.00	0.00	15.00	30.00	45.00
Soybean meal	22.50	18.65	14.65	13.15	9.15
Brewers dried grain	10.65	6.00	5.50	0.00	0.00
Wheat brain	7.00	7.50	5.00	0.00	0.00
Additional contents[a]	9.85	9.85	9.85	9.85	9.85
Calculated chemical composition					
Crude protein (%)	21.96	19.85	19.58	19.13	19.09
M.E. ($MJKg^{-1}$)	11.59	11.89	11.85	12.12	11.83

[a]In addition, each diet contained fish meal, 5.00%; bone meal, 3.00%; oyster shell, 0.50%; common salt, 0.35%; vitamin/mineral premix, 0.50%; methionine, 0.25%; and lysine, 0.25%.

The objective of this study was to determine the effect of feeding very high levels of PKC (up to 45% inclusion) on growth rate, carcass characteristics, meat quality and feed cost per unit live weight gain.

Materials and Methods

Experimental birds and feeding trial: A total of 150 Marshall broiler chicks were brooded together and fed a formulated starter diet (Table 1) from one day old till they attained 3 weeks of age. Thereafter, the chicks were randomized into 4 treatment groups, with 3 replicates per group and 12 birds per replicate. Each treatment group was fed one of four finisher diets formulated to contain 0%,15%, 30%, and 45% mechanical expeller palm kernel cake (Table 1). Feed intake was determined daily on replicate basis whilst live weight was measured weekly also on replicate basis. Throughout the experiment, feed and water were provided *ad-libitum*. The feeding trial was terminated at the 62nd day of age (8 weeks and 6 days).

Determination of carcass characteristics and organoleptic quality: The procedures for the measurement of carcass and organ weights and assessment of organoleptic quality were as described in Okeudo *et al.* (2005). Briefly, 36 birds (3 from each replicate) were selected after the termination of the feeding trial and sacrificed. Birds of similar live weights were selected, except when none is available. Birds were starved overnight and thereafter slaughtered and dressed following conventional procedure. The weights of the carcasses and the organs were recorded. One drumstick from each carcass was used for the determination of cooking loss. Drumsticks were packaged individually in double layer polythene bags and boiled in water for 30 minutes. The difference in weight of the drumstick before cooking and after cooking was expressed as a percentage of the weight before cooking and referred to as the percent cooking loss. Approximately one half of the flesh from each of the remaining 36 drumsticks were obtained and used for the assessment of organoleptic quality. Samples were washed individually in clean water, immersed for a few seconds in a brine solution (containing super-saturated brine diluted with an equal volume of water), package in a transparent double layer polythene bag and tagged for identification. Thereafter, they were boiled in water for 30 minutes, cooled under room temperature and served to a panel of 12 assessors previously trained in basic organoleptic assessment procedure. Each panelist was required to masticate 3 samples and score each for tenderness, juiciness, flavour and degree of likeness using the 9 points category rating scale (AMSA, 1978). It was planned that the 3 samples offered to each panelist must come from three different dietary groups. The remaining flesh from the second drumstick was scraped off and the weight of the bone determined. The weight of the bone expressed as a percentage of the fresh drumstick weight was regarded as percent bone content.

Statistical analyses: The analysis of variance test was conducted for each parameter using the completely randomized design. While analyzing the data from the carcass and meat quality assessment, each bird was treated as a replicate. This increased the number of replicates to 9 per treatment group. Mean separation was achieved by the least significant difference (LSD) test as described by Little and Hills (1978).

Results and Discussion

The calculated chemical composition of the broiler finisher diets (Table 1) shows that the four finisher diets were similar in metabolizable energy and crude protein contents. The crude protein content varied from 19.09% (45% PKC diet) to 19.85% crude protein (0% PKC diet) whilst the metabolizable energy content varied from 11.83 MJ Kg^{-1} (45% PKC diet) to 12.12 MJ kg^{-1} (30% PKC diet). The cost of feed decreased with increasing PKC level (Table 2) such that the 0% PKC diet was 11%, 15% and 28% more expensive than the 15%, 30% and 45% PKC diets, respectively. This suggests that in practical terms the utilization of PKC diets would result in considerable savings in poultry feeding.

Table 2: Feed intake, live weight gain and feed cost per gain as affected by dietary palm kernel cake level

Parameter	Palm kernel cake level (%)				SEM
	0	15	30	45	
Initial live weight (kg) [1]	0.35	0.37	0.34	0.33	0.01
Final live weight (kg) [2]	2.00[a]	1.86[a]	1.99[a]	1.53[b]	0.07
Average feed intake (kg/bird/day)	0.120	0.131	0.133	0.127	0.005
Average live weight grain (kg/bird/day)	0.040[a]	0.036[a]	0.040[a]	0.029[b]	0.016
Feed conversion ratio	2.98[a]	3.59[a]	3.30[a]	4.36[b]	0.180
Feed cost (N)	60.52	54.28	50.96	43.88	
Feed cost (N) / weight gain (kg)	180.34	194.86	168.16	191.31	9.37

[a,b]Means in a row being different superscripts are significantly different (P < 0.05).
N = Nigerian Naira; 1 U.S. $ = N128. [1]21 days of age; [2]62 days of age,

Average daily feed intake was similar across the four dietary treatments, and differences were not statistically significant (P > 0.05). Ezieshi and Olomu (2004) also did not observe any significant difference in feed intake between broiler finishers fed 0%, 34% and 44.95% PKC diets. Earlier studies by Onwudike (1986b) did not record any significant variation in feed intake when broiler finishers were fed diets containing 0%, 11.67%, 23.33%, 35.00%, 46.67% and 58.33% PKC. These results indicate that inclusion of PKC in compounded broiler finisher rations have little or no effect on feed intake. Final live weight, average daily gain and feed conversion ratio did not vary between the 0%, 15% and 30% PKC inclusion levels, whereas counterparts fed the 45% PKC diet suffered a significant depreciation (Table 2). Evidence exist showing that broiler finishers can be fed diets containing 35% PKM level without suffering a significant reduction in growth performance (Onwudike, 1986b) and up to 40% PKC level with methionine and lysine supplementation (Panigrahi and Powel, 1991). In this present study, broilers fed the 45% PKC diet still suffered significant reductions in performance even with 0.25% lysine and 0.25% methionine supplementation. Because of cost implications, higher levels of supplementation with these essential amino acids in commercial poultry diets are not feasible in Nigeria today. According to our estimate, formulating a broiler finisher diet with 1.0% lysine and 0.5% methionine supplementation would increase the cost of the entire ration by 27%. The 35% PKM diet fed to broiler finishers by Onwudike (1986b) also contained 6.8% fish meal. With the current high cost of fish meal in Nigeria, such a formulation may no longer be accepted as a least cost ration. Taken together, the optimum inclusion level of PKC in least cost commercial broiler finisher rations should not exceed 30% without lysine and methionine supplementation or a high fish meal inclusion level.

The cost of the ration required to produce one kilogram of live weight was not affected by the level of PKC inclusion (Table 2). Thus, the significant reduction in growth rate and the significant increase in feed conversion ratio (associated with broilers reared on the 45% PKC diet) were compensated by the relatively lower cost of the feed. This implies that farmers would not suffer any financial loss by feeding a diet containing 45% PKC. Contrariwise the large population of small scale poultry producers in Nigeria would benefit from a relatively lower feed cost which translates into a lower production cost. Secondly, the medium slaughter weight of broilers fed the 45% PKC diet (1.5kg) is in higher demand by hotels, restaurants and fast food enterprises in Nigeria. It is pertinent to note that Onwudike (1986b) and Ezieshi and Olumu (2004) had reported significant reductions in feed cost per gain with increasing PKC inclusion rates. A close examination of the report of Ezieshi and Olomu (2004) reveals that the diets formulated by these authors were remarkably cheaper than the diets formulated in this study. Their diets did not contain fish meal, nor any other animal protein supplement and lysine and methionine supplementations were fixed at 0.10% each. Certainly, the cost of feed intake per gain would depend on the comparative costs of the different ingredients utilized and their inclusion levels. Many decades ago in Nigeria palm kernel cake and brewers' dried grain were treated as valueless agro-industrial wastes, till their usefulness as important ingredients in poultry feeding was recognized. From that time, these by-products are sold for cash, alongside other conventional feed ingredients.

The dressing percentage and organ proportions as affected by PKC inclusion level is presented in table 3. Dressing percentage was highest amongst the broilers fed the 30% PKC diet, and differed significantly (P < 0.05) from broilers fed the 0% PKC and 45% PKC diets. Reports exist indicating that PKC inclusion level had no effect on dressing percentage (Onwudike, 1986a, Okeudo *et al.*, 2005) whereas in another report dressing percentage was positively affected by PKC dietary level (Okon and Ogunmodede, 1996). However, there is general agreement that gizzard size is positively influenced by PKC inclusion level, which is consistent with our current observation. Results on cooking loss and organoleptic quality are presented in Table 4. None of the parameters showed diet-related differences (P > 0.05). This contradicts our earlier report (Okeudo *et al.*, 2005) which indicated that broilers fed diets containing PKC were rated higher in organoleptic flavour than counterparts fed PKC - free diets. This suggests that

Table 3: Dressing percentage and organ proportions

Parameter	PKC level (%) 0	15	30	45	SEM
Dressing (%)	66.39[a]	67.37[ab]	72.05[b]	64.56[a]	1.74
Organ proportions (%)					
Head	2.72[a]	2.45[b]	2.41[b]	2.81[a]	0.56
Neck	4.41	4.62	3.77	4.28	0.38
Shank	2.32	2.03	2.12	2.15	0.10
Heart	0.54	0.59	0.53	0.52	0.05
Intestines	5.97	6.17	6.38	7.06	0.57
Gizzard (empty)	2.43[a]	2.84[b]	2.84[b]	3.49[c]	0.61
Drumstick	5.48	5.13	5.20	5.27	0.18
Liver & gall bladder	2.41	2.35	2.18	2.23	0.11
Bone	23.15	21.67	24.13	19.95	1.45

[a,b]Means in a row bearing different superscripts are significantly different ($P < 0.05$).

Table 4: Cooking loss and organoleptic quality

Parameter	Palm kernel cake level (%) 0	15	30	45	SEM
Cooking loss (%)	9.25	10.56	9.57	12.67	1.62
Tenderness[1]	7.56	7.56	8.00	7.56	0.30
Juiciness[1]	7.00	7.22	7.22	7.22	0.30
Flavour[1]	7.56	7.00	7.22	6.78	0.35
Hedonic cores[2]	7.44	7.89	7.33	7.11	0.25

[1]Scoring was based on the 9 point category rating scale: Extremely (tender / juicy / flavoured) = 9; very (tender / juicy / flavoured) = 8; moderately (tender / juicy / flavoured) = 7; slightly (tender / juicy / flavoured) = 6; neither (tender / juicy / flavoured) nor (tough / dry / unflavoured) = 5; slightly (tough / dry / unflavoured) = 4; moderately (tough / dry / unflavoured) = 3; very tough / dry / unflavoured) = 2; extremely (tough / dry / unflavoured) = 1. [2]Hedonic scoring: Like extremely = 9; like very much = 8; like moderately = 7; like slightly = 6; neither like, nor dislike = 5; dislike slightly = 4; dislike moderately = 3; dislike very much = 2; dislike extremely = 1.

inclusion of PKC would not always result in differences in meat flavour. It is known that PKC produced by the mechanical expeller technique contains considerable residual oil (Chin, 2002) and invariably should undergo rancidity and develop off-flavours during storage. Thus incorporation of old PKC in broiler finisher diets may alter the meat flavour characteristics.

From the results obtained in this study, we conclude:

1. Feed intake is not affected by PKC inclusion level, even up to the 45% inclusion rate.
2. Although live-weight gain and feed conversion ratio were adversely affected at the 45% level of PKC inclusion, feed cost per gain was not affected. Thus, farmers should not suffer a reduction in financial returns by feeding broiler finishers the 45% PKC diet.
3. Organoleptic quality of broilers was not affected by incorporating PKC in the diet, even up to the 45% inclusion level.

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