PALM KERNEL CAKE AS AN INGREDENT FOR ENHANCED GIZZARD ACTIVITYAND IMPROVED NUTRIENT DIGESTIBILITYIN FINISHER BROILER CHICKENS

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Abstract

The study was designed to evaluate the potential of palm kernel cake(PKC) to cause an enhanced gizzard activity, and hence an improved nutrient digestibility when incorporated into the diet of broiler finisher chickens. It was conducted on the backdrop of reducing production cost, not only through sourcing alternative feed ingredients, but that of improving or enhancing the capacity of the birds to extract much nutrients from the feed they consume, and on the assumption that PKC, acting as grit (for its gritty nature) in the diet could stimulate the gizzard to maximum functionality. PKC was incorporated at 0, 15, 20, 25 and 30% levels to diets designated T1, T2, T3, T4 and T5 respectively. Two hundred brooded broiler chicks were used for the feeding trial which lasted for 35 days. Each of the five diets was replicated four times with each replicate containing ten birds in a completely randomized design. The birds that received PKC in diet had higher dry matter retained than the control treatment. This trend was maintained for the digestibility of individual nutrients such as crude protein, crude fiber, nitrogen free extract, ether extract and metabolizable energy. The experimental unit that received PKC at 20% level in diet showed better digestibility for almost all the parameters considered. The birds that received PKC in diet had higher mean weight of full gizzard, empty gizzard, entire GIT and small intestine, while the gall bladder weight was significantly ($P<0.5$) reduced among them. The length of the GIT and the relative length of small intestine were significantly increased among birds that received PKC in diet, whereas the relative length of the large intestine and caeca were reduced among them. It was concluded that adding PKC in the diet of finisher broiler chicken will improve nutrient digestibility as a result of increase in gizzard activity and functionality. It was thus recommended that poultry farmers could add PKC at 20% level in the diet of finisher broiler chickens to improve nutrient digestibility and weight gain, and that further research could be carried out using other grit materials.

Key words: Gizzard, Palm-kernel cake, Gastro-intestinal tract, Grit.

1.0 INTRODUCTION

Feed cost constitute the single most important cost in livestock production in general, and poultry production in particular, just as the rising cost of poultry feed ingredients have constituted an impediment to the sufficient availability of animal protein to meet the demand of ever increasing human population, particularly in the developing countries of the world (Uko and Kamalu, 2003). Arresting this trend will require that efforts should be shifted not only to the use of alternative feed ingredients such as agricultural byproducts, that have no much competition from human consumers and industrial processors, but also to harnessing maximally the potential of the poultry birds to optimally extract nutrients from the feed they consume. It was on this premise that PKC, a byproduct of palm kernel oil extraction was proposed to be added in the diet of finisher broiler chickens to aid the gizzard in its role of grinding and mixing of feed materials. The feeding trial was conducted on the assumption that feeding PKC in the diet of broiler chickens will enhance the capacity of the gizzard in breaking feed particles and exposing them more to the action of the enzymes in the GIT, thereby optimizing digestion and nutrient availability.

2.0 MATERIALS AND METHODS

PKC was collected from palm kernel oil mills. A total of 200 brooded broiler chicks were used for the study that lasted for 35 days (finisher phase only). The brooded chicks were randomly allocated to five treatment diets, each treatment being replicated four times with ten birds per replicate. The experimental birds were fed five levels of PKC viz – 0, 15, 20, 25 and 30. The experimental diets and water were given ad-libitum throughout the duration of the experiment. All management protocols were strictly observed. At a week to the end of the feeding trial, nutrient retention (digestibility) trial was conducted using a total fecal collection method. All proximate analysis was conducted following the A.O.A.C (1990). Statistical package for social sciences (SPSS) Version 16.0 software (2006) was used for statistical analysis. Duncan multiple range test at 5% level of significance was used to separate the means where there were significant differences.The ration composition for the various treatment diets is presented in Table 1, while proximate composition of experimental diet is presented in Table 2.

Table 1: Composition of diets for finisher broiler chicken.

	Diets (% palm kernel cake)				
	T1(0%)	T2(15%)	T3(20%)	T4(25%)	T5(30%)
Maize	64.30	54.00	50.00	47.00	45.00
SBM	25.40	18.00	15.00	12.00	8.00
PKC	--	15.00	20.00	25.00	30.00
Blood meal	4.00	5.00	6.00	7.00	8.00
Palm oil	3.00	4.00	5.00	5.00	5.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.40	0.40	0.40	0.40	0.40
Methionine	0.30	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00	100.00
Calculated compositions					
ME (kcal/kg)	3000	2990.00	2982,00	2915.00	2832.00
Crude protein (%)	20,00	20.00	20.00	20.00	20.00
Crude fiber (%)	2.95	4.75	4.76	4.78	5.00
Calcium (%)	1.20	1.20	1.20	1.20	1.20
Phosphorus (%)	0.66	0.63	0.63	0.60	0.60
Lysine (%)	1.27	1.12	1.10	1.00	1.00
Methionine (%)	0.56	0.57	0.56	0.55	0.55

SBM soya bean meal, PKC palm kernel cake, Premix Animal care$^{(R)}$ vitamin/mineral premix included at 0.25%, to provide 24000 iu vitamin A, 6000 iu vitamin B, 60mg vitamin E, 5mg vitamin B_3, 2mg Folic acid, 80 mg niacin, 4mg vitamin B_1, 10mg vitamin B_2, 7mg vitamin B_6, 0.04 vitamin B_{12}, 0.016mg biotin and 250mg anti oxidant per kg diet. The mineral values per kg diet were; cobalt 0.5mg, copper 16mg, selenium 0.5mg, iodine 24mg, iron 80mg, manganese 140mg, zinc 120mg and chloride 400mg

Table 2: proximate composition of finisher diet

Parameter	**Diets (PKC %)**				
	T1 (0)	**T2(15)**	**T3 (20)**	**T4 (25)**	**T5 (30)**
Crude Protein(%)	19.53	19.55	19.50	19.50	19.55
Crude Fiber(%)	3.85	5.10	5.21	5.40	5.45
Crude Fat(%)	4.26	4.04	3.73	3.61	3.60
NFE(%)	57.01	55.90	56.12	55.92	55.28
Ash(%)	6.80	6.67	6.41	6.25	6.00
Moisture(%)	8.95	8.94	9.03	9.02	9.11
M.E (kcal/kg)	3000.13	3000.47	3000.37	2983.46	2976.20

ME=,Metabolizable energy, NFE= Nitrogen free extract.
Metabolizabe energy calculated from the determined proximate composition using the formular: M.E = 37 (% CP) + 81.8 (% EE) + 35.5 (% NFE) (Pauzenga, 1985).

3.0 RESULTS AND DISCUSSION

3.1 Results

3.1.1 Feed and nutrient digestibility of finisher broiler chickens fed levels of palm kernel cake (PKC) in diet

The digestibility of feed and nutrients by finisher broiler chickens is presented in Table 3. There was significant (P<0.05) difference in the digestibility of nutrients by the addition of PKC in the diet of finisher broiler chickens. The digestibility of dry matter, crude protein, crude fiber, ether extract, nitrogen free extract and metabolizable energy were all higher among birds that received PKC in diet than the control diets. The birds that received PKC at 20% level showed higher digestibility for each of the parameters than the rest treatment units.

Table 3: feed and nutrient digestibility of finisher broiler chickens fed levels of palm kernel cake (PKC) in diet

Parameters	**Diets (%PKC)**						
	T1(0)	T2(15)	T3 (20)	T4 (25)	T5 (30)	SEM	P
Dry matter (%)	67.00^{cd}	69.75^{b}	71.00^{a}	67.50^{c}	69.75^{b}	1.04	0.011
Crude protein (%)	67.75^{c}	70.50^{b}	71.25^{a}	67.50^{cd}	71.50^{a}	0.84	0.017
Crude fiber (%)	70.50^{b}	68.00^{d}	72.00^{a}	68.50^{cd}	70.00^{b}	1.06	0.017
Ether extract (%)	70.25^{c}	71.25^{b}	74.50^{a}	69.00^{d}	72.25^{b}	0.95	0.045
NFE (%)	69.50^{c}	72.50^{b}	74.00^{a}	66.50^{d}	71.75^{b}	0.93	0.025

^{a,b,c}means on the same row with different superscript are significantly different (P<0.05). NFE= Nitrogen free extract.
SEM , Standard Error of Means

3.1.2 Internal organs parameters of finisher broiler chickens fed diet containing graded levels of palm kernel cake

The internal organs parameter of finisher broiler chickens is presented **in Table 4** The addition of PKC in the diets resulted in increase in the mean weight of the full gizzard, empty gizzard, entire GIT and small intestine. It however, caused reduction in the mean weight of the gall bladder, large intestine and caeca.

Table 4: internal organs parameters of finisher broiler chickens fed diet containing graded levels of palm kernel cake

Parameters	Diets (% live weight)						
	T1	T2	T3	T4	T5	SEM	P
Heart weight (%)	0.50	0.50	0.40	0.40	0.40	0.042	0.175
Lungs weight (%)	0.60	0.575	0.750	0.450	0.438	0.051	0.327
Full gizzard (%)	2.00^{c}	2.00^{c}	3.73^{ab}	4.33^{a}	3.24^{b}	0.247	0.040
Empty gizzard (%)	1.50^{c}	1.75^{c}	2.20^{ab}	2.40^{a}	2.00^{b}	0.050	0.017
Proventriculus (%)	0.65	0.65	0.65	0.78	0.50	0.379	0.356
Gall bladder (%)	0.30^{a}	0.30^{a}	0.10^{c}	0.15^{b}	0.15^{b}	0.088	0.034
Liver weight (%)	2.00	2.00	2.20	2.10	2.10	0.186	0.372
GIT weight (%)	4.00^{d}	5.50^{a}	5.50^{a}	5.20^{b}	4.50^{c}	0.703	0.049
Small intestine (%)	3.00^{c}	5.00^{a}	5.00^{a}	4.00^{b}	3.50^{c}	0.418	0.048
Large intestine (%)	0.60^{a}	0.30^{b}	0.30^{b}	0.18^{c}	0.20^{c}	0.464	0.053
Ceaca weight (%)	1.00^{a}	0.70^{b}	0.60^{bc}	0.50^{d}	0.56^{c}	0.582	0.036
Spleen weight (%)	0.20	0.20	0.20	0.17	0.17	0.488	0.560

^{a,b,c}means on the same row with different superscript are significantly different ($P<0.05$).

SEM , Standard Error of Means

3.1.3 Effect of the addition of palm kernel cake on the GIT relative length of finisher broiler chickens.

Effect of the addition of palm kernel cake on the GIT relative length of finisher broiler chicken is presented in Table 5

The length of the GIT and the relative length of the small intestine were higher among birds that received PKC in diet, while the relative length of the large intestine and caeca were lower among them than the control birds.

Table 5: effect of the addition of palm kernel cake on the GIT relative length of finisher broiler chickens

Parameters	Diets						
	T1	**T2**	**T3**	**T4**	**T5**	**SEM**	**P**
GIT length (cm)	162.75^{d}	249.50^{a}	248.00^{a}	231.25^{c}	246.75^{ab}	27.12	0.016
Small intestine (%)	66.50^{c}	80.30^{a}	80.30^{a}	68.00^{b}	80.00^{a}	19.14	0.031
Large intestine (%)	8.00^{a}	4.00^{c}	5.00^{b}	3.80^{c}	5.00^{b}	30.65	0.016
Ceaca (%)	18.25^{a}	14.00^{d}	16.25^{b}	15.00^{c}	16.00^{b}	27.75	0.039

^{a,b,c}means on the same row with different superscript are significantly different (P<0.05).

SEM , Standard Error of Means

3.2 Discussion

The high digestibility of dry matter, crude protein, crude fiber and most other nutrients among experimental units that received PKC in diet could be explained from the findings of Hetland*et al*. (2003) who observed that grit abrasion of feed particles in the gizzard breaks fibrous materials and larger particles into smaller bits for enzymatic actions. This increases the surface area of the particles, improving their contact with the endogenous enzymes in the GIT, thereby improving nutrient digestion. Abdollahi*et al*. (2014) also reported that feeding of coarse material in the diet of broiler chickens stimulates the gizzard to additional grinding activity. The addition of PKC in the diet of finisher broiler chickens therefore, may have enhanced the grinding activity of the gizzard because of the coarse and gritty nature of PKC. This could be the reason the birds that received PKC in diet had better digestibility for all the parameters considered. This result is in agreement with the findings of Agidi *et al*. (2018) and Idachaba*et al*. (2013) who noted a better dry matter, crude protein, crude fiber and metabolizable energy digestibility when grit was added in the diet of finisher broiler chickens.

The increase in the mean weight of the gizzard among birds that received PKC in diet could be related to the increase in volume content of the gizzard as reported by Svihus (2011a) and corroborated by Sacranie*et al*. (2012), that grit stone acting as structural components on gizzard muscle stimulate an increase in gizzard volume content. This could be the reason birds that received PKC in diet had higher mean weight of the full gizzard than the control birds. Also, the higher mean weight of the empty gizzard among birds that received PKC in diet may be related to gizzard development that occurred by the presence of PKC (grit) in the diet. Svihus (2011a) suggested that the addition of coarse material in the diet of broiler chickens, stimulate proper development of the walls of the gizzard to positively affect its functionality. This could have

accounted for the reasons the mean weight of empty gizzard was higher among birds that received PKC in diet.

The increase in the mean weight of GIT, and the relative mean weight of the small intestine among birds that received PKC in diet could be for the reason of the bulk the presence PKC added to the diet. Gonzalez-Alvarado *et al*. (2008) reported that chickens adapt to coarse diets by increasing the volume and weight of their digestive tracts. The reduction in the relative mean weight of the gall bladder by the addition of PKC in the diet could be the result of increased release of bile contained in the gall bladder due to increased digestive activities. This is consistent with the findings of Svihus*et al*. (2004a) and Hetland*et al*. (2003), that an increased gizzard activity causes a stimulating effect for the release of bile and enzyme secretions. This according to them happen due to the gizzard mediated vaso-vagal reflexes and increased cholecystokinin (CCK) release in the pyloric region. The addition of PKC in the diet could have further stimulated the release of these chemicals. This is consistent with the findings of Agidi*et al*. (2018) who reported a significant reduction in the relative mean weight of the gall bladder when gizzard activity was improved by the addition of sand grit in the diet of finisher broiler chickens.

The increase in the length of the GIT and the relative length of the small intestine among birds that received PKC in diet could be a physiological response to create more room for the absorption of the extra nutrients that was the outcome of the increased digestive activities by the presence of PKC in the diet. This agrees with Solomon and Berg (2002) which stated that digestive organs can physiologically respond to change in diet structure. It is also in agreement with the stand of Svihus (2011a), who stated that coarse materials in the diet of broiler chickens can stimulate increased development of digestive organs in other to positively affect their functionality. The shorter relative length of the large intestine and caeca among birds that received PKC in diet than the control birds could be an indication of proper nutrient digestion and absorption that took place in those birds, leaving the large intestine and the caeca with little or no work to do. Steve (2008) and Agidi*et al*. (2018) noted that the large intestine and the caeca are sites for water re-absorption and fermentation of undigested feed materials respectively. Therefore, the higher relative length of these segments of the GIT among the control birds could be because they were actively engaged in re-absorbing excess water, and the fermentation of food materials that escaped proper digestion and absorption in the upper GIT.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

It was concluded that the addition of PKC to the diet of broiler finisher chicken enhanced gizzard activity and improved feed efficiency.

4.2 Recommendations

i) Poultry farmers can add PKC at 20% level in the diet of finisher broiler chickens to improve nutrient digestibility and weight gain.

ii) Further research can be carried out on other grit materials.

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