Agricultural Journal 2 (6): 646-650, 2007
ISSN: 1816-9155

Nutrient and Mineral Retention of Broilers Fed Periwinkle Flesh

B.I. Okon and A.A. Ayuk
Department of Animal Science, Faculty of Agriculture, University of Calabar,
Calabar Cross River State, Nigeria

Abstract: The apparent nutrient and mineral retention of broilers fed periwinkle flesh in place of fishmeal was determined. One hundred and eighty day-old hyperco broiler chicks were used for this study, which lasted 8 weeks. Broilers were assigned to 5 experimental diets in a completely randomized block design. Diet 1 which served as control was a commercial broiler ration while diets 2-5 contained various levels of fishmeal, periwinkle flesh, palm kernel cake and palm kernel oil. At 7 weeks, 2 birds per replicate were selected for metabolic trials. Broiler chickens fed 2 or 4% PKO along with 25% PKC and 3% periwinkle flesh (diets 4 and 5) retained significantly more nutrients than the rest of the birds. Similarly, birds on 2 or 4% PKO along with 25% PKC and 3% periwinkle flesh had significantly higher retention of Ca, P and Fe than others. Results suggest improved apparent nutrient and mineral retention with the introduction of PKO, although the level of PKO inclusion was not significant.

Key words: Periwinkle, palm kernel oil, nutrient, mineral, retention

INTRODUCTION

The poultry feed situation in Nigeria today is in a precarious position. This is due to scarcity and high cost of available conventional ingredients, unexplored local sources of ingredients and dearth of scientific data in respect of the nutrient quality of locally available feed ingredients amongst others. According to Ogbonna and Ige (2002) acute shortage and high prices of feed ingredients are responsible for the present rise in poultry and livestock products. Animal proteins are known to be more preferable and better compared to that of plant protein based on balanced amino acid profile (Akinnusi *et al*., 2007). In Nigeria as well as in most developing countries, the inclusion of fish meal in livestock feeds makes the resultant animal feed very expensive. Therefore, it is imperative that alternative feed ingredients be sourced that can replace fish meal and equally render the feed cheap while providing the necessary nutrients for good health, growth and production.

To make up for the shortfall and attendant high prices of conventional ingredients like fishmeal, cheaper and locally available sources have to be explored. The periwinkle flesh is one such ingredient. Periwinkle are marine molluscs dominant in the brackish waters (Ndifon *et al*., 1997). They contain higher levels of crude protein per unit dry weight than whole hen's egg (Mba, 1980). However, since their use in broiler ration is limited, it will be instructive to see how its inclusion in broiler diets will affect their apparent nutrient and mineral retention.

Research has shown that the addition of fat to poultry diet increases the metabolizable energy of the diets more than expected from metabolizable energies of individual ingredients (Matteos and Sell, 1980; Fanimo and Fashina-Bombata, 1998; Oso *et al*., 2007). Palm oil is a regular feature in livestock feed formulation (Agonlahor and Ayinde, 2002). The increasing competition between the various uses of palm oil has made it imperative for researchers to explore possible uses of palm kernel oil in place of palm oil.

Palm kernel oil is extracted or expressed from the palm kernel. The oil is light yellow in colour resembling coconut oil in taste and smell, although less pungent (Oyenuga, 1968).

It contains a level of saturated fatty acids, with lauric, myristic and oleic acids being predominant. The presence of natural antioxidants together with a low content of chemically reactive fatty acid chain provides palm kernel oil with a good natural resistance to oxidation (Weiss, 1970).

This research was therefore, designed to look at the effect of feeding periwinkle flesh to broilers in place of fishmeal with respect to nutrient and mineral retention in the presence of palm kernel oil.

Corresponding Author: B.I. Okon, Department of Animal Science, Faculty of Agriculture, University of Calabar, Calabar Cross River State, Nigeria

MATERIALS AND METHODS

One hundred and eighty hyperco broilers birds were raised from day-old to 8 weeks of age at the teaching and research farm of the university of Ibadan, in south-western Nigeria.

Experimental design and diets: The broilers were randomly assigned to 5 experimental diets in a completely randomised block design. There were twelve birds per replicate and each treatment had 3 replicates. Feeding of the experimental animals was *ad libitum* and all animals had free access to fresh cool water.

The experimental diets (treatments) were formulated as shown in Table 1. Diet 1(the control) had no Periwinkle Flesh (PF) and no Palm Kernel Cake (PKC). In diet 2,the level of PKC was 15% while in diets 3-5 the PKC was fixed at 25%. Whereas diet 2 contained no PF diet 3 had 6%PF.Equally while in diet 4 PF was added at 3% and Palm Kernel Oil (PKO) was introduced at 2%, diet 5 had 3%PF and 4%PKO.

Table 1: Gross composition of experimental diets

Ingredients (%)	1	2	3	4	5
Maize	50.00	40.20	42.39	31.20	24. 71
Groundnut cake	18.62	11.95	10.78	13.95	14.04
Fish meal	2.00	2.00	0.00	0.00	0.00
Blood meal	5.00	5.00	5.50	5.00	5.00
Palm kernel cake	0.00	25.00	25.00	25.00	25.00
Periwinkle flesh	0.00	0.00	6.00	3.00	3.00
Brewer's dried grain	8.98	8.00	6.00	10.00	10.00
Wheat offal	11.55	4.40	1.88	6.60	10.00
Bone meal	3.00	2.10	1.70	2.00	3.00
*vitamin premix	0.25	0.25	0.25	0.25	0.25
DL-methionine	0.20	0.20	0.20	0.20	0.20
L-lysine	0.00	0.00	0.40	0.40	0.40
Palm kernel oil	0.00	0.00	0.00	2.00	4.00
Salt	0.40	0.40	0.40	0.40	0.40
Total	100.00	100.00	100.00	100.00	100.00
Analysed nutrient composition of diets					
Crude protein	23.09	22.97	22.99	23.03	23.00
Crude fibre	4.30	6.02	4.73	6.44	6.60
M.E.Kcal kg^{-1}	4.23	4.49	4.64	4.52	4.37
Ether extract	2800.06	2800.22	2800.28	2799.61	2800.96
L-lysine	1.05	1.04	1.26	1.36	1.38
Dc-methionine	0.52	0.54	0.49	0.50	0.50
Ca g kg^{-1}	1.34	1.03	1.27	1.14	1.51
Pg kg^{-1}	0.66	0.52	0.43	0.47	0.62
Protein, energy ratio	121.27	121.91	121.80	121.61	121.87

*The following were present per kg: Vit. A9, 000.000 I.U, Vit. D., 1280.000 I.U. Vit. E 7,000 I. U, Riboflavin 6,000 mg, Vit B_3, 2,200 mg, Vit B_5 14,000 mg, Lysine 120,000 m g^{-1}, Methionine 65,000 mg, Chlorine chloride, 240,000 mg, Mn 60,000 mg, Fe 35,000 mg, Cu 5,000 mg, Se 100 mg, Anti oxidant

Nutrient and mineral retention: When the experimental birds were 7 weeks old, two birds were randomly selected from each replicate and placed in metabolic cages. These birds were allowed 2 days to acclimatise in the cages after which they were given known weights of experimental diets containing red ferric oxide as a marker.

Droppings containing the marker were collected for a 5 day period. During the collection, boric acid powder was sprinkled daily on the droppings to reduce loss of ammonia (NH_3) and hence Nitrogen (N). On collection, the droppings were weighed fresh after feathers and other contaminants had been separated. The weighed droppings were then oven dried at 60°C for 72 h, after which they were they were allowed to cool in a desiccator, weighed and milled.

The proximate components of the droppings were then determined using the A.O. A.C. (1990) methods of analysis. The percentage retentions of the minerals, fats, nitrogen, fibre and energy were calculated using the general formular:

$$\frac{A \times B - C \times D}{A \times B} \times 100\%$$

Where,

A = Feed intake during period of metabolic study (g).
B = Percentage of parameter in feed.
C = Dry weight of droppings voided (with marker) during the period of metabolic study.
D = Percentage of parameter in droppings.

Statistical analysis: The feeding trial was based on the completely randomised block design and data collected were subjected to the Analysis of Variance (ANOVA) method of Steel and Torrie (1980). Significant values were compared using the Duncan's multiple range test.

Apparent nutrient retention: Table 2 shows that dietary inclusion of 2% or 4% palm kernel oil in rations containing high levels of palm kernel cake and periwinkle flesh

Table 2: Apparent nutrient (%) retention of experimental diets

	Detary treatments				
Nutrients	1	2	3	4	5
Nitrogen	$68.49\pm1.01_{b}$	$68.02\pm2.14_{b}$	$70.17\pm1.92_{ab}$	$73.04\pm3.46_{a}$	$74.43\pm1.43_{a}$
Fat	$72.43\pm5.41_{b}$	$71.63\pm3.16_{b}$	$73.02\pm4.06_{a}$	$75.15\pm4.06_{a}$	$76.02\pm1.40_{a}$
Fibre	$24.30\pm1.03_{b}$	$25.96\pm3.04_{b}$	$26.45\pm0.49_{b}$	$28.23\pm6.29_{a}$	$28.48\pm3.34_{a}$
Ash	$65.96\pm3.92_{b}$	$66.06\pm1.04_{bb}$	$67.01\pm3.13_{bb}$	$69.09\pm2.33_{aa}$	$69.96\pm2.08_{a}$
Energy	$53.63\pm2.37_{b}$	$52.05\pm3.35_{b}$	$51.05\pm1.54_{c}$	$57.57\pm3.32_{a}$	$58.15\pm6.46_{a}$

Values denoted by different subscripts for a given nutrient were significantly different ($p<0.05$)

Table 3: Proximate composition of droppings from birds

	Detary treatments				
Composition	1	2	3	4	5
Nitrogen	1.04±0.05	1.15±0.25	1.01±0.36	1.05±0.16	1.07±0.35
Ether extract	$1.46\pm0.51_{b}$	$1.31\pm0.63_{b}$	$1.51\pm0.17_{ab}$	$1.69\pm0.09_{a}$	$1.94\pm0.24_{a}$
Fibre	13.01±1.05	13.42±2.97	12.61±1.54	13.92±2.14	13.46±1.01
Ash	22.13±1.01	23.05±3.41	20.97±1.07	22.43±2.22	$22.65\pm1.06_{a}$
Moisture	$40.06\pm2.35_{b}$	40.06±3.03	39.02±1.64	39.05±3.02	39.94±2.13
Nitrogen free extract	17.43	15.98	20.57	16.44	15.34
Gross energy kcal g^{-1}	2.68±0.86	2.64±1.71	2.66±0.16	2.74±1.64	2.76±0.53

Values denoted by different subscripts for a given percentage proximate were significantly different ($p<0.05$)

Table 4: Apparent mineral retention (%) of experimental birds

	Detary treatments				
Minerals	1	2	3	4	5
Ca	$68.72\pm2.81_{a}$	$59.74\pm2.65_{b}$	$66.01\pm2.14_{a}$	$70.04\pm6.73_{a}$	$71.64\pm7.03_{a}$
P	$62.43\pm1.96_{b}$	$62.86\pm2.14_{b}$	$62.76\pm3.02_{b}$	$65.05\pm1.61_{ab}$	$68.26\pm3.14_{a}$
Mg	64.12±2.68	60.07±3.41	65.03±2.42	66.67±3.33	66.98±4.35
Mn	61.53±2.96	61.94±2.54	59.98±1.32	64.26±3.49	63.86±1.41
K	65.76±3.13	65.66±6.51	64.09±2.81	64.41±4.62	65.01±3.04
Na	62.86±1.72	60.97±3.06	62.66±1.44	63.92±2.27	65.954±2.40
Fe	$67.56\pm1.91_{b}$	$69.42\pm3.01_{a}$	$67.63\pm1.27_{b}$	$69.86\pm2.09_{a}$	$70.43\pm3.14_{a}$

Values denoted by different subscripts for a given mineral were significantly different ($p<0.05$)

Table 5: Minerals (%) in droppings from experimental birds

	Detary treatments				
Minerals	1	2	3	4	5
Mean wt of feed intake (g)	127.00±1.06	127.00±1.06	127.00±1.06	127.00±1.06	127.00±1.06
Mean wt of droppings on DM basis	50.33±1.96	51.42±4.01	$50.67\pm3.21_{b}$	52.05±2.53	52.16±1.94
Ca %	0.37±0.14	0.36±0.02	0.40±0.03	0.41±0.01	0.43±0.02
P %	0.19±0.01	0.18±0.04	0.15±0.04	0.20±0.04	0.22±0.03
Mg %	0.14±0.02	0.13±0.02	0.14±0.01	0.13±0.02	0.15±0.02
K %	0.15±0.01	0.18±0.01	0.16±0.01	0.15±0.01	65.954±0.01
Mn PPm	77.00±2.43	75.47±4.12	75.57±2.05	76.67±3.94	78.47±3.23
Na PPm	182.51±3.86	185.43±4.39	193.49±3.14	189.96±4.54	190.42±3.11
Fe PPm	187.46±6.14	187.18±4.03	191.16±3.19	190.43±6.16	189.91±1.57

stimulates significantly ($p<0.05$) better nutrient retention. No significant difference ($p>0.05$) existed between values for the 2 or 4% palm kernel. Also, no significant difference ($p>0.05$) was observed in the retention of nitrogen, fat, fibre, ash and energy, when the birds were given either high fish meal or high periwinkle flesh in palm kernel cake ration (diets 2 and 3). Indeed, values for the two groups were not significantly different from those for the control group. Table 3 gives the apparent nutrient composition of the droppings.

From the study, it appeared that when PKO and 25%PKC were fed along with 3% periwinkle flesh a significant effect was observed. Broiler chickens fed 2 or 4% PKO along with 25% PKC and 3% periwinkle flesh (diets 4 or 5) retained significantly more nutrients than the rest of the birds. The conclusion therefore, is that PKO improves the apparent nutrient retention, but this retention is not related to the level of PKO included in rations.

Apparent mineral retention: The presence of 2% or 4% palm kernel oil in the high palm kernel cake and high periwinkle flesh ration increased the retention of P and Fe (Table 4). Retention of Ca, P and Fe by the control group (diet 1) and diet 3 group were not significantly different ($p>0.05$). Table 5 gives the percentage of minerals present in the droppings of the experimental birds.

When PKO was fed along with 25% PKC and 3% periwinkle flesh, it was observed that PKO significantly enhanced the percentage retention of Ca, P and Fe. Birds fed 2% or 4% PKO along with 25%PKC and 3% periwinkle, had significantly higher mineral retention in relation to the feeding of high level PKC along with periwinkle flesh in the absence of PKO. Ofovbe (1987) and Akpet (1987) had separately reported that inclusion of palm kernel oil in broiler rations improved the performance of broiler chicks in terms of weight gain, mineral retention, vitamin requirements and utilization. The percentage apparent mineral retention values reported in this trial are

higher than those reported by Whitehead *et al.* (1972). Increasing dietary PKO in this trial did not significantly increase the apparent retention of Ca. This is inconsistent with the findings of Ogunmodede and Ogunlela (1971), who reported that an increase in Ca absorption by Rhode Island Red pullets when palm oil was fed. However, the findings reported in this trial appear to be in agreement with the reports of Whitehead *et al.* (1972) and Hakansson (1975) who reported that increasing dietary fat level interfered with mineral metabolism, reducing Ca and Mg retention and bone and Mg contents. Such reductions in mineral retention they attributed to the formation of insoluble soaps that were not absorbed. Nevertheless, the differences in results may also be due to the type of fats and oils, their levels of inclusion and the strain of the birds used.

The apparent retention of P like that of Ca did not increase with an increase in dietary PKO. This appears contrary to the findings of Ogunmodede and Sanni (1975) who reported that increasing the level of palm oil increased P absorption. Although PKO inclusion did not exceed 4%. The adding of PKO in this study did not significantly affect the retention of Mg, Mn, K and Na. This is inconsistent with the findings of Whitehead *et al.* (1971) and Hakansson (1975). The findings in respect to Mn is also not in agreement with the report of Ogunmodede and Sanni (1975) who reported a favourable apparent absorption of Mn with an increase in the dietary oils used.

The differences in results could be due to the types of oils used. It has been reported, in literature that saturated fatty acids interfere with the absorption of some minerals. While oleic and palmitic acids are the predominant fatty acids in palm oil, lauric and myristic acids are the predominant fatty acids in palm kernel oil. It would appear therefore, that PKO contains more saturated fatty acids than palm oil and this would mean that PKO is likely to interfere more with the absorption and subsequent retention of some the minerals. Ofovbe (1987) reported a decrease in the absorption of Ca, Mg, Fe and Zn with an increase in dietary fat concentration.

The apparent Fe retention values obtained in this trial are higher than those reported by Waddell and Sell (1964) and Sell (1965). The feeding of dietary PKO increased the retention of Fe. Touchburn and Naber (1966) and Jensen *et al.* (1970) observed an "extra calorie effect" for supplemental fat suggested that wider calorie protein ratios for poultry rations with additional fat could be used for maximum gains and efficiency. This increase however, was not related to the level of PKO used. This does not agree with the report of Whitehead *et al.* (1971) who reported a decrease in Fe retention in the presence of any type of fat at or above 5%. The difference in results might well be due to the type and level of fat fed.

CONCLUSION AND RECOMMENDATION

The current scarcity and high cost of livestock feeds especially poultry feeds, calls for the search for local ingredients that could profitably be used in feeding poultry. From the study conducted, the introduction of PKO significantly increased the apparent retention of nutrients, although this increase was not related to the level of inclusion. While the retention of Mg, Mn, K and Na was not affected by the introduction of PKO, PKO nevertheless affected the retention of Ca, P and Fe significantly.

The levels of saturated fatty acids present in PKO and the probable presence of some mineral binding proteins are suggested as the possible explanation for these effects.

It is therefore, recommended that further research be carried out to establish the level of PKO that can be most profitably be fed to broiler chickens.

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