Nutritional Evaluation of Yam Peel Meal for Pullet Chickens:1. Effect of Feeding Varying Levels on Performance from Day- Old to Point-of-Lay

*** E.V. Ezieshi, O.E. Uwadia, F.O. Ayonote and J.M. Olomu**

Department of Animal Science, University of Benin, Benin City.
**e-mail: ev.ezieshi@yahoo.com.*

Abstract

Studies were conducted to determine the effect of replacing 0, 25, 50, 75 and 100% dietary maize with yam peel meal (YPM) on performance characteristics of pullet starter and grower chicks. Consequently, five experimental diets were fed to 150 Anak pullet chicks from day-old to point-of-lay to cover the starter phase (1 to 9 weeks of age) and the grower phase (10 to 20 weeks of age). The results of the pullet starter trial indicated that final body weights (g/bird) were in the order of 479.2, 404.8, 469.2, 442.5 and 350.0 for 0, 25, 50, 75 and 100% respectively. Feed intake values (g/bird) were in the order of 3184, 3281, 2953, 3235 and 3251. Feed cost per bird (₦) resulted in values of 215.3, 197.3, 155.4, 146.0 and 122.3. Average daily water intake values (ml/bird/day) were 72.6, 75.0, 69.0, 71.2 and 71.9. Similarly, the results of the trial with pullet growers indicated final body weights (g/bird) of 1336, 1260, 1255, 1260 and 883. Total feed intake (g/bird) resulted in values of 4728, 4964, 4334, 4038 and 3936. Feed cost per bird (₦) decreased linearly with increasing levels of dietary YPM and resulted in values of 279.55, 261.50, 200.37, 160.63 and 131.17. Average daily water intake (ml/bird/day) was in the order of 180.6, 172.2, 191.0, 231.9 and 218.0. From the results of the studies it can be concluded that YPM can substitute up to 75% of maize in the diets of pullet starter and grower chicks without adverse effects on performance and at reduced cost of production.

Keywords: Nutritional evaluation, yam peel meal, pullet, performance.

Introduction

Consequent upon the high demand for maize, its regular supply cannot be guaranteed. As a result, maize is often quite expensive. When used as a major source of energy in poultry diets, maize increases cost of production which ultimately affects prices of poultry products and overall animal protein intake.

Yam peel meal (YPM) is an agricultural by-product which is obtained from the processing of yam into food. Unlike maize, it is not edible to man and may not be useful in the industries. It is readily available and if not properly managed may constitute nuisance in our environment. Studies with YPM revealed that it can replace up to 15% of dietary maize for broiler starter and finisher chickens without adverse effects on performance (Ekeyem *et al., 2006,* Akinmutimi and Onen, 2008). Results of further studies also indicated that YPM can successfully replace up to 40% of dietary maize for broiler chickens without deleterious effects and at reduced cost of production (Inaku *et al.,* 2010). Information on the use of YPM for pullets is scarce and its optimum inclusion level for pullets has not been fully worked out. Thus, it has become necessary to determine the effect of replacing 25, 50, 75

and 100% of maize in the diet of pullet chicken with YPM.

Materials and Methods

Site of Study: The experiments were conducted at the Poultry Research Unit of the University of Benin Teaching and Research Farm, Ugbowo Campus, Benin City.

Source of Test Material: The yam peels used in these studies were predominantly from the variety of white yam and were obtained from a number of eateries, household kitchens and restaurants in Benin City as by-product of yam processing. The material was obtained wet and sun-dried to reduce the moisture content and then milled before being incorporated into the diets.

Chicks, Housing and Management: A total of 150 Anak pullet chicks purchased at day-old from a commercial hatchery was used for the studies. The chicks were reared on deep litter in a standard tropical open-sided poultry building divided into pens measuring about 2.5 by 1.5m each. The birds were brooded during the first four weeks of age. During this period, the open-sided portions of the pens were covered with polythene sheets. Each pen was provided with a 200-watt electric bulb to provide optimum temperature. The birds were vaccinated according to schedule. Coccidiostat and antibiotics were administered at regular intervals to prevent coccidiosis and bacterial infections. Throughout the experiment, feed and water were supplied *ad libitum*. The mean temperature was 35^{o}C with diurnal temperature range of 3^{o}C.

Diets: Five diets were tested during the study. The compositions of the diets are shown in Table 1. Diet 1 which served as the control diet had 60% maize. In the other diets, 25, 50, 75 and 100% of the maize in the control diet was quantitatively replaced with YPM. Therefore, Diet 2 (25% replacement of maize) contained 45% maize and 15% YPM, Diet 3 (50% replacement of maize) contained 30% maize and 30% YPM; Diet 4 (75% replacement of maize) contained 15% maize and 45% YPM while Diet 5 (100% replacement of maize) contained 0% maize and 60% YPM. The control diet was formulated to contain 16% crude protein and 2700kcal/kg metabolizable energy (Olomu 1995). The study was conducted in two phases: the pullet starter and grower phases. Same diets were employed for the two phases of the study in line with the recommendation of Olomu (1995) that diets containing 16% crude protein could be used to rear pullet chicks from day-old to point-of-lay.

Experimental Design: The day-old chicks were placed on a commercial pullet starter mash for one week to acclimatize them before the start of the experiment. At one week of age, the chicks were divided into 15 groups at 10 birds per group. The weights of all the groups were equalized based on average chick weight of 44.44g. Three of such groups were randomly assigned to each of the five dietary treatments in a completely randomized design. Each group constituted a replicate. The starter phase lasted from 1 to 9 weeks of age. At the end of the pullet starter phase, the birds were fed a common diet for one week before the commencement of

the grower phase so as to neutralize the effect of the starter diets on the pullets. The grower phase lasted from 10 weeks of age to point-of-lay (20 weeks).

Data Collection: The pattern of data collection was the same for the two phases. The chicks were observed daily and a record of mortality was kept. The body weights of the birds were recorded on weekly basis. From the final body weight values, weekly body weight gains were determined. This was calculated by taking the difference in weight between the final and initial body weights for the week. Feed intake was also determined on weekly basis. Feed intake was calculated as the difference in weight between the initial and final feed with respect to each experimental week. Daily water intake per bird was determined. This was done by providing a known quantity of water per day to each group. Twenty-four hours later, the balance water for each group was weighed. The difference was then divided by the number of birds in the pen to obtain the daily water intake per bird. This was done for three consecutive days of each week and the average value was taken as the average daily water intake for that week.

Statistical analysis: Data collected during the trial were subjected to analysis of variance using the completely randomized design and mean separation was done where there were significant differences (SAS, 2002).

Table 1: Percentage Composition of Pullet Diets

	Diet (percentage replacement)				
Ingredients	**1(0%)**	**2(25%)**	**3 (50%)**	**4(75%)**	**5(100%)**
Maize	60.00	45.00	30.00	15.00	00.00
Yam peel meal	0.00	15.00	30.00	45.00	60.00
Soya bean meal	15.40	15.40	15.40	15.40	15.40
Wheat bran	20.00	20.00	20.00	20.00	20.00
Bone meal	03.00	03.00	03.00	03.00	03.00
Salt	00.35	00.35	00.35	00.35	00.35
Premix	00.25	00.25	00.25	00.25	00.25
Limestone	01.00	01.00	01.00	01.00	01.00
	100.00	100.00	100.00	100.00	100.00
Cost per kg diet (N)	67.62	60.12	52.62	45.12	37.62
Calculated Analysis					
ME, kcal/kg	2,713.84	2,647.99	2,581.84	2,516.29	2,450.44
Crude protein, %	15.83	16.31	16.80	17.28	17.77
Crude fibre, %	3.89	4.97	6.05	7.14	8.22
Total phosphorus, %	0.94	0.95	0.96	0.97	0.98
Calcium, %	1.30	1.32	1.33	1.35	1.37
Lysine, %	0.91	0.98	1.06	1.14	1.22
Meth + cystine, %	0.53	0.51	0.50	0.48	0.47

1. Supplied per kg diet: vitamin A, 12,000iu; vit E, 30mg; miacin, 40mg; biotin, 0.5mg; vit. B_1, 2.25mg; vit. B_2, 6mg; vit B_6, 4.5mg; vit. B_{12}, 0.15mg; vit. K_3, 2mg; pantothenic acid, 15mg; vit. D_3, 2500iu; folic acid, 1.5mg; choline chloride, 300mg; cobalt, 0.5mg; copper, 5mg; iodine, 1.0mg; iron, 20mg; manganese, 80.0mg; selenium, 0.2mg; zinc, 50mg; antioxidant, 0.125mg.

Results

The results of the trial with pullet starter chicks (1 to 9 weeks of age) are presented in Table 2. The results indicated that final body weights and body weight gain were not significantly (P>0.05) affected by the replacement of dietary maize with YPM up to 75% level. The replacement of 100% maize in Diet 5 resulted in significant decrease in body weight. However, the mean values of body weights observed with the birds fed Diet 5 were not significantly (P>0.05) different from those observed with those fed Diets 2 and 4. Total feed intake per bird was not significantly (P>0.05) affected by the replacement of maize with YPM except at 50% level which resulted in significant depression in feed intake. However, the feed intake value recorded with the birds fed Diet 3 with 50% replacement was not significantly (P>0.05) different from those recorded with those fed Diets 1, 4 and 5. The results also showed that with the exception of Diet 3 which recorded significant decrease, feed to gain ratio increased with increase in the level of replacement. However, the increase in feed to gain ratio was only significant (P<0.05) when all the maize in the diet was replaced with YPM.

Feed cost per bird decreased linearly with increasing level of replacement of maize with YPM. The replacement of 50, 75 and 100% dietary maize with YPM resulted in decrease in feed cost per kilogram liveweight gain. Water intake per bird decreased at 50% replacement level. However, the value of water intake observed at this level was not significantly (P>0.05) different from those values observed at 0, 75 and 100% levels of replacement. Water to gain ratio was not significantly (P>0.05) affected when YPM replaced dietary maize with YPM at 50 and 75% levels of replacement. The replacement of 25 and 100% dietary level of maize with YPM resulted in significant (P<0.05) increase in feed to gain ratio. Water to feed ratio was not significantly (P>0.05) affected by diets. Energy consumed per bird was significantly (P<0.05) depressed at 50% replacement level. Protein consumed per bird significantly increased at 75% and 100% replacement levels.

Table 2: Effect of Substituting Yam Peel Meal for Maize on Performance Characteristics of Pullet starter chicks (1 to 9 weeks of age) Diet (% Replacement).

	Diet (%replacement)					
Performance characteristics	**1(0%)**	**2(25%)**	**3(50%)**	**4(75%)**	**5(100%)**	**SEM**
Initial body weight (g/bird)	44.44	44.63	44.63	44.63	44.81	
Final body weight (g/bird)	479.2^{a}	404.8^{ab}	469.2^{a}	442.5^{ab}	350.0^{b}	0.11
Total body weight gain (g/bird)	434.7^{a}	360.1^{ab}	424.6^{a}	397.9^{ab}	305.4^{b}	27.95
Total feed intake (g/bird)	3184^{ab}	3281^{a}	2953^{b}	3235^{ab}	3251^{ab}	90.49
Feed to gain ratio (gfeed/ggain)	6.72^{bc}	8.23^{ab}	6.30^{c}	7.31^{bc}	9.29^{a}	0.47
Feed cost per bird (N)	215.3	197.3^{b}	155.4^{c}	146.0^{c}	122.3^{d}	4.81
Feed cost per kg weight gain (N)	0.46^{a}	0.50^{a}	0.33^{c}	0.33^{c}	0.35^{c}	0.03
Water intake (ml/bird/day)	72.6^{ab}	75.0^{a}	68.9^{b}	71.2^{ab}	71.8^{ab}	1.49
Water to gain ratio (ml/g)	8.56^{c}	10.5^{ab}	8.26^{c}	9.01^{bc}	11.5^{a}	0.53
Water to feed ratio (ml/g)	1.28	1.28	1.14	1.23	1.24	18.45
Energy consumed (kcal/bird)	8641^{a}	8689^{a}	7624^{b}	8140^{ab}	7967^{ab}	233.94
Protein consumed (g/bird)	504^{b}	535.2^{ab}	496.1^{b}	559^{a}	577.7^{a}	15.18

1. Means within rows with same or no superscripts are not significantly ($p>0.05$) different.
   SEM: Standard Error of Means.

The results of the trial with pullet grower chicks are presented in Table 3. The results indicated that final body weight was significantly ($P<0.05$) depressed by the replacement of dietary maize with YPM. There was no significant difference in body weight among the groups of birds fed the YPM- based diets except the group fed Diet 5, where all the maize was replaced with YPM, which recorded a significantly lower value compared to others. The results indicated that initial body weight was significantly ($P<0.05$) depressed only at 100% replacement level. Similarly, total body weight gain significantly ($P<0.05$) decreased at the level where all the maize was replaced with YPM. There was a significant ($P<0.05$) increase in total feed intake by the chicks when 25% of dietary maize was replaced with YPM. Subsequently, beyond 25% level of replacement, feed intake significantly decreased at 50% replacement level. The value of feed intake recorded by the birds fed Diet 3 (50%) was significantly ($P<0.05$) lower than that recorded by the birds fed Diet 1. Feed intake decreased further with the

replacement of 75% and 100% dietary maize with YPM in Diets 4 and 5 which recorded almost similar values of feed intake. The replacement of dietary maize with YPM at 50% and 75% levels did not significantly ($P>0.05$) affect feed to gain ratio. Feed to gain ratio significantly ($P<0.05$) increased at 75% replacement level. There was a further increase in feed to gain ratio when 100% of the maize was replaced with YPM. Metabolizable energy intake decrease linearly with increasing level of replacement. However, the replacement of maize in the diet at 25% level with YPM did not significantly ($P>0.05$) affect energy intake. Crude protein intake significantly increased at 25% replacement level and decrease subsequently beyond 25% level of replacement. There was no significant difference in crude protein intake among the birds fed Diets 3, 4 and 5. Feed cost per bird decreased with increasing level of replacement. Water intake by the birds increased only slightly at 50% replacement level and significantly at 75 and 100% levels. There was a slight decrease in water intake at 25% level of replacement. Similarly, water to feed ratio decreased significantly ($P<0.05$) at 50% level of replacement. There was a further increase in water to feed ratio at 75 and 100% replacement levels which resulted in almost similar ratios. Water to gain ratio increased with increasing levels of replacement.

Table 3: Effect of substituting yam peel meal for maize on performance characteristics of pullet growers. (10 to 20 weeks of age).

Performance characteristics	Diet (%replacement)					
	1(0)	2(25)	3(50)	4(75)	5(100)	SEM
Final body weight (g/bird)	1335.7[a]	1259.5[b]	1255.1[b]	1260.4[b]	882.9[c]	20.68
Initial body weight (g/bird)	500.0[a]	492.9[a]	485.7[a]	492.9[a]	451.2[b]	9.37
Total body weight gain (g/bird)	835.6[a]	766.6[a]	769.4[a]	767.5[a]	421.1[b]	23.49
Total feed intake (g/bird)	4,728[b]	4,964[a]	4,334[c]	4,038[d]	3,936[d]	53.52
Feed to gain ratio (g feed/g gain)	5.46[c]	6.92[b]	5.66[c]	5.26[c]	9.13[a]	0.30
Metabolizable energy intake (kcal/bird)	12,830[a]	13,143[a]	11,190[b]	10,162[c]	9,645[d]	131.2
Crude protein intake (g/bird)	748.4[b]	809.7[a]	729.7[bc]	697.9[c]	699.3[c]	9.68
Feed cost per bird (N)	279.55[a]	261.50[b]	200.37[c]	160.63[d]	131.17[e]	1.80
Feed cost per kg weight gain (N)	322.7[ab]	364.6[a]	261.9[c]	209.6[d]	304.5[b]	15.25
Water intake (ml/bird/day)	180.6[bc]	172.2[c]	191.0[b]	231.9[a]	218.0[a]	4.29
Water to feed ratio	2.670[c]	2.423[d]	3.08[b]	3.91[a]	3.89[a]	0.037
Water to gain ratio	15.15[d]	15.87[cd]	17.42[c]	21.15[b]	35.49[a]	0.63

Means within rows with the same or no superscripts are not significantly (P>0.05) different.
SEM: Standard Error of Means.

Table 4: Proximate Composition of Yam Peel Meal and Maize (as fed)

Proximate Composition (%)	*** Yam Peel**	**** Maize**
Moisture	7.26	8.20
Dry matter	92.74	91.80
Crude protein	12.03	8.80
Crude fibre	9.31	2.10
Ether extract	1.03	4.10
Ash	8.56	1.00
Nitrogen-free extract	61.81	75.80
Total phosphorus	0.28	0.21
Calcium	0.12	0.01
Lysine	0.83	0.31
Methionine + Cysteine	021	0.31

* Determined
** Olomu (1995)

Discussion

The results obtained with the pullet chicks indicated that body weights tended to decrease with increasing level of replacement of maize with YPM. The poor performance of birds fed the YPM diets compared to the control diet (without YPM) may be related to the higher crude fibre level of the diets. Results of the chemical composition (Table 4) indicated that the crude fibre content of YPM is about 4 times higher than that of maize. It has been reported that fibre serves as an energy diluent (McDonald *et al*., 1983) thereby, interfering with energy utilization. Total feed intake appeared to increase with the YPM-based diets, except for Diet 3 (50%) compared with control diet probably due to the lower energy levels of the diets. The increased feed to gain ratio observed on YPM diets can be attributed to the lower body weights recorded on the diets compared to control diets as observed during the pullet starter phase. Feed cost

per bird generally decreased with increasing levels of replacement of maize with YPM. This may be related to the difference in cost per kilogram maize and YPM. Maize was about four times more expensive than YPM during the period of study.

The decrease in body weights observed with the grower pullets fed YPM–based diets may be due to lower metabolizable energy (ME) levels of the diets compared to that of control diet without YPM. Moreover, the results presented in Table 3 showed that ME and CP intake by the birds decreased linearly with increase in the dietary levels of YPM. The lower levels of ME of the YPM diets coupled with the decreased intake of essential nutrients may be responsible for the depressed performance of the birds fed the YPM diets. Ezieshi and Olomu (2007) reported that birds raised on low energy diets recorded lower body weights compared to those on higher energy diets. The grower pullets fed YPM diets consumed less feed than those fed control diet. This observation is not in agreement with the findings of Ezieshi and Olomu (2004) who reported that birds would eat more to meet their energy requirement .The reduced feed intake by the birds as dietary levels of YPM increased may be related to the bulky nature of the YPM-based diets. Yam peel meal was found to be highly bulky thereby, limiting feed intake by the birds .This may be the reason for the significantly lower level of feed intake on Diet 5 with 100% replacement of maize compared to other YPM diets. The decreased feed intake by the birds fed YPM-based diets was probably the reason for the decreased ME and CP intake on the diets. The decrease in feed cost per bird was not surprising since YPM was relatively cheaper than maize at the time of the study. The increase in water intake observe with the birds fed the YPM-based diets was probably an attempt by the birds to consume adequate water to be able to handle the increased level of dietary crude fibre following the increased percentage replacement of maize with YPM. Neumann (1977) reported that large amount of water is required in the gastro-intestinal tract to soften the fibrous tissues prior to digestion. The increase in water intake as dietary crude fibre increased is in agreement with the findings of Ezieshi and Olomu (2008). The linear increase in water intake by the birds with increased percentage replacement of maize with YPM can also be attributed to increased dietary level of YPM. Water intake is known to be affected by the increase in the proportion of a particular component in the diet (Marks and Pesti, 1984).

Conclusion

From the results of the study, it can be concluded that YPM can replace up to 75% of the maize in the diets of starter and growers pullets without any adverse significant effects on performance and at reduced cost of production.

References

Akinmutimi, A.H. and Onen, G.E (2008). The response of broiler finisher birds fed graded levels of yam peel meal in place of maize

based diets. *International Journal of Poultry Science*, 7:474-477.

Ekeyem, B.U and Madubuike, F.N. and Dike O.F. (2006). Effect of partial replacement of yam peel meal (*Dioscorea spp)* for maize on performance and carcass characteristics of finisher broiler chickens. *International journal of poultry science* 5 (10): 942 – 945.

Ezieshi, E.V. and Olomu, J.M. (2004). The effect of replacing maize with maize offal on the performance of broiler chickens. *Journal of Agriculture Forestry and fisheries (*J.A.F.F,). *5(1) 5-9*

Ezieshi, E.V. and Olomu, J. M. (2007): Nutritional evaluation of palm kernel meal types: 1 Proximate composition and metabolisable energy values. African Journal of Biotechnology. Vol. 6 (21): 2484-2886.

Ezieshi, E.V. and Olomu, J. M. (2008): The biochemical evaluation of millet offal as feed for broiler chickens. Pakistan Journal of Nutrition 7(3): 421-425

Inaku, E.N., Bawa. G.S., Olugbemi, T.S. and Buba, W. (2010). Nutritive value of yam peel meal in broiler diets. Proc. 36th Conf., Nig. Soc. For Anim. Prod. 13-16 March, 2011. Univ. of Abuja, Nigeria. Pp 414-417.

Marks, H. I. and Pesti, G. M. (1984): Alteration of protein levels in laying rations at various stages within the laying circle. Poultry science 63: 1617-1625.

Mc Donald, P; Edward, R.A. and Greenhalgh, HFD. (1983). Palm kernel meal in animal nutrition (4th ed). Longman, Harlow Pp: 462 – 463.

Neumann, A. L. (1977): Dry roughage and their uses in finishing rations. In: *Beef cattle*, 7th edition, John Wiles and sons, New York. Pp 523-554.

Olomu, J.M. (1995). Feeds and feed ingredients. In: *Monogastric animal nutrition*- Principles and practices. A Jachem publication, Benin City. Pp 108-110.

SAS (2002). Statistical Analysis system proprietary Software. SAS Institute Inc., Cary, NC.