DETERMINATION OF THE OPTIMAL DIETARY INCLUSION LEVEL OF YAM-TUBER (*DIOSCOREAE ROTUNDATA)* PEEL MEAL AND ECONOMY OF PRODUCTION FOR BROILER STARTER CHICKS.

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Abstract
A 28-day feeding trial was conducted to determine the optimal dietary level of yam tuber-peel meal and economy of production for broiler starter chicks. Yam tuber peel meal was incorporated in broiler starter diets at 0,15, 25 and 35% levels partially replacing maize meal as source of energy. One hundred and eighty (180) day-old broiler-chicks (Marshall breed) were divided into four groups of 45 birds each and assigned to the four experimental diets in a Completely Randomized Design (CRD). Each group was further replicated thrice of 15 birds per replicate. The performance of the group of chicks on each of the three levels of inclusion (15, 25 and 35%) were compared with those obtained from the group of chicks on the control diet (0% inclusion level). The performance of the birds on 0 and 15% inclusion levels compared favourably in all parameters (P>0. 05). Significant differences were observed (P<0. 05) in average final body weight and average body weight gain. In average daily body weight gain, average daily feed intake, and feed conversion ratio, significant differences (P<0.05) were observed between the groups in 0 and 15% inclusions on one hand and the groups on 25 and 35% inclusion levels on the other. In economy of production, as the feed cost decreased from 0% to 35% inclusion levels, cost of production of chicks increased from 0% to 35% inclusion levels. The decreasing trend in performance of the chicks from those on 0% to those on 35% inclusion levels was observed to be due to increasing level of fibre in the diets. As the yam-tuber-peel meal increased, there was concomitant drop in energy. It was concluded that yam-tuber meal should not exceed 15% inclusion level in broiler starter diet.

Keywords: Yam-tuber, peel, broiler starter, performance, economy of production.

Introduction

The poultry industry in Nigeria, for example, is undergoing stress because most of the inputs (chicks, feedstuff, micro/macro-nutrients, equipment) are imported. Import policies/duties pronounced are now and again not sustained or adequately enforced. Thus, in addition to steady depreciation of the *Naira* (Nigeria's currency name), poultry production input costs keep rising (Ihekoronye and Ngoddy, 1998) even till date - 2015 The resultant effect is that the average Nigerian citizen cannot afford to buy poultry products.

Durunna and Nwabunor (2002) reported that the situation is further aggravated by man's and industrial needs for the same inputs (maize groundnuts, wheat, soyabean, millet, sorghum) required for poultry production. These factors — importation of inputs, depreciation of the value of Nigeria's currency (Naira), ever rising cost of inputs, low demand for finished products due to high costs and serious competitive demand for available production inputs by man, industries and poultry business — have gradually and steadily been pushing poultry business out of existence. There is therefore need to identify alternative feedstuffs that are locally available, affordable and adequate for poultry production. One such alternative feed material is yam tuber peels.

Seventy five percent of world yam tubers are grown in West Africa and Nigeria produces 26.10^6 Mt/pa (Kenyon *et al.* 2006). As a result, yam tubers generate abundant yam tuber peels in restaurants, hotels, and family kitchens where yam tubers are either cooked, roasted or fried for food and the peel disposed off as waste.

Studies with yam tuber peel meal (Ekenyem *et al*, 2006; Akinmutimi and Onen, 2008; Ezieshi and Olomu, 2011) revealed that it can replace up to 75% of maize in broiler finisher diet without adverse effect on performance and at reduced cost of production.

Information on yam-tuber peels as feed ingredient for starter broiler is scanty and far between. The study herein reported was designed to determine the optimal level of inclusion of yam tuber peel meal and its economy of application as feed ingredient in broiler starter diet.

Materials and Methods

The experiment was carried out in the Poultry Unit of the Research farm of the Federal University of Technology, Owerri (FUTO), Nigeria. The yam tuber peels were collected from various fried yam centers in Ihiagwa, Imo State, Nigeria - a satellite town close to the University. The fresh yam tuber peels were a mixture of peels from *turn around* and *peel-away* methods of handling yam tubers for peeling. In *turn-around* method, yam tuber piece of 2.5 - 7.5cm (1 - 3 inches) thick was cut and held in one hand. The knife in the other hand was used to peel the yam piece while being turned around clock wise. In *peel away* method, the whole yam

tuber was held in the left hand in a slanting position and placed on a platform, and with the knife in the right hand, the yam is peeled downwards away from the peeler. The peels were sun dried for 3 days and milled using a 3mm sieve to obtain the meal. Samples of the meal were subjected to proximate analysis according to AOAC (1995) (Table 1).

Four (4) experimental diets were formulated such that diet 1 (control) contained no yam peel meal while diets 2,3 and 4 contained yam peel meal (YPM) at 15.25 and 35% levels, respectively, correspondingly replacing dietary maize meal (Table 2). One hundred and eighty (180) unsexed day old broiler chicks (Marshall breed) were used. They were divided into four (4) groups of 45 chicks each and each group (which was further divided into 3 replicates of 15 chicks each) was assigned to the four experimental diets using Completely Randomized Design (CRD). The groups were designated T_1, T_2, T_3 and T_4 corresponding with 0,15, 25 and 35% inclusion levels respectively. The chicks were raised on deep litter floor and all routine management practices were applied. Feed (weighed) and water were provided *ad libitum*. Left over feed was collected and weighed. The value obtained was subtracted from the weight of feed fed. The difference was recorded as feed consumed. The chicks performance was evaluated on the following parameters: - initial body weight, final body weight, body weight gain, daily weight gain, daily feed intake, feed conversion ratio and cost of production.

At the end of the experiment, the chicks in each group were weighed to obtain their final body weights. The values were divided by 45 (number of chicks in each group) and by 28 (days the investigation lasted) to obtain their average daily body weight gain. The total weight of the feed consumed by each group was also divided by 45 and by 28 to obtain the average daily feed intake of a chick. The body weight gain was obtained by subtracting the initial body weight from the final body weight. The value was divided by 45 to obtain value for a chick. Feed conversion ratio (FCR) was obtained by dividing the total quantity of feed consumed by the total weight gained. The feed cost (N/Kg) was realized by dividing the total cost of the ingredient (plus transport cost) by the total kilogram of the feed produced for each group. Cost of production for each bird was determined by multiplying feed 'cost (N/Kg) by feed conversion ratio.

Data collected were subjected to analysis of variance (ANOVA) according to Snedecor and Cochran (1978). Where significant treatment effects were detected, means were compared using Duncan's New Multiple Range Test (DNMRT) as outlined by Obi (1990).

Results and Discussion

The proximate composition of the yam tuber peel meal (YPM) is presented in Table 1. The ingredient composition of the experimental diets (dry matter) is presented in Table 2 and the performance of the experimental birds is summarized in Table 3. The performance of the group on 15% inclusion level compared favourably ($P>0.05$) with those of the group on 0% in all parameters examined. The final body weight gain of T_1 and T_2 (640.llg and 633.33g respectively) as a group, showed significant difference ($P<0.05$) between them as that of T_3 and that of T_4 with those of T_3 and T_4 (604.86g and 516.62g respectively). Similar observation was made for average body weight gains 489.14 and 482.19g for T_1, and T_2 on one hand and 435.56 and 367.19g for T_3 and T_4 respectively on the other. Result values decreased as the inclusion levels of the peel meal increased. The trend of the result agrees with the reports of Ezieshi and Olomu (2011) on the use of YPM for poultry production. The average daily weight gain of the groups followed the same trend with the values: 17.50, 17.22, 13.20 and 13.04g for T_1, T_2, T_3 and T_4 respectively. The values in the reports on this parameter (daily weight gain) by Ekenyem *et al* (2006) and Akinmutimi and Onen (2008), did not conform with those of this investigation. A close observation on the yam-tuber peels revealed that no two peels were alike. They differ either in length or depth of the ground tissue which accompany the cortex (periderm inclusive) as yam peel. Thus, it implies that the quantity of the yam- tuber's ground tissue and cortex utilized for every investigation would differ. Invariably, results would differ even though the same material was utilized. It appears therefore that every research about yam peel meal is unique.

The average daily feed intake was 39.67, 40.67 41.54 and 42.l0g for T_1, T_2, T_3 and T_4 respectively. The crude fibre content of the feed was 6.17, 7.14, 7.65 and 8.46g for T_1, T_2, T_3 and T_4 respectively. The values obtained for these parameters were significantly different ($P<0.05$) when tested statistically. It was noted that while the fibre content of the feed increased, feed intake increased as well. The chicks in group T_2, T_3, and T_4 consumed more feed to satisfy their energy requirement as the feeds contained higher fibre values than T_1. It was noted that feed consumption and fibre content in the feed were positively correlated. The inability of the chicks to digest higher fibre content in their feed, was reflected in the lower finishing weights observed in groups T_3 and T_4. The digestive system of the chicks were yet to develop enough to handle higher fibre content in feed.

Table I. *Proximate composition of yam-tuber (Dioscoreae rotundata) peel meal (%)*

Parameter	Value
Moisture	11.37
Dry matter (DM)	88.63
Crude protein	11.85
Crude fibre	9.45
Ether extract	1.08
Ash	8.67
Nitrogen-free extract	68.91

Table 2: *Ingredients composition of the experimental diets (% DM)*

Ingredients	T_1	T_2	T_3	T_4
Maize meal	50.00	35.00	25.00	15.00
Yam tuber peal meal	00.00	15.00	25,00	35.00
Soya bean meal	11.00	11.00	11.00	11.00
Groundnut cake	17.00	17.00	17.00	17.00
Brewers spents grain	13.00	13.00	13.00	13.00
Fish meal	3.00	3.00	3.00	3.00
Bone meal	2.00	2.00	2.00	2.00
Oyster shell meal	3.00	3.00	3.00	3.00
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
*Vit/Trace mineral (premix)	0.25	0.25	0.25	0.25
Calculated Chemical Analysis (%)				
Crude protein	23,10	22.46	22.19	22.06
Crude fibre	6.17	7.14	7.62	8.46
Ether extract	4.33	3.76	3.38	3.01
Calcium	1.96	2.69	3.11	2.53
Phosphorus	0.56	0.53	0.36	0.58
ME (Kcal/kg)	3096.00	2806.00	2714.35	2592.15

DM = dry matter

**To provide the following per kg of feed:- Vitamin A: 1000000iu, Vitamin D_3: 200iu, Vitamin B_1, 0.75mg, Nicotinic acid: 25mg Calcium pantothenate: 12.5mg, Vitamin B_{12}: 2.5mg, Vitamin K_3: 2.3mg, vitamin E:12mg, Cobalt: 0.40mg, Biotin: 0.50mg, Folic acid: 1.00mg, Chlorine chloride: 2.5mg, Copper 5mg, magnesium: 64mg, Iron: 32mg, Zinc: 4mg, Iodine:0.80mg, flavomycin; 5mg, \Methianine:50mg, Selenium. 0.16mg, L-lysine 120mg*

The feed conversion ratio (FCR) of the respective groups (T_1, T_2, T_3 and T_4) was 2.27, 2.36, 3.15 and 3.38. The chicks in group T_1 and T_2 converted feed to tissue significantly better ($P<0.05$) than those in groups T_3 and T_4. This observation agrees with the reports of Ndubuisi *et al*. (2009) and Siyanbola and Amao (2011).

The feed cost per kilogram of feed produced was N72.28, N68.98, N66.78 and N64.58 for T_1, T_2, T_3 and T_4 respectively. No statistical significant difference ($P>0.05$) except arithmetic was observed on the feed cost parameter. This outcome, agrees with the report by Akinmutimi and Onen (2008), Ezieshi and Olomu, (2011). However, the performance of the chicks in this work peaked at 15% inclusion when compared with the report of Ezieshi and Olomu, (2011).

Table 3: ***Performance of broiler-starter chicks fed graded levels of yam-tuber (Dioscoreae rotundata) peel meal as source of energy.***

Parameter	T_1 (0%)	T_2 (15%)	T_3 (25%)	T_4 (35%)	SEM
Av.initial body weight (g)	150.97	151.14	150.55	151.43	-
Av. final initial body weight (g)	640.11[a]	633.33[a]	604.86[b]	516.62[c]	10.62
Av.body weight gain(g)	489.14[a]	482.19[a]	435.56[b]	367.19[c]	7.37
Av.daily weight gain(g)	17.50[a]	17.22[a]	13.20[b]	13.04[b]	1.27
Av. daily feed intake(g)	39.67[a]	40.67[a]	41.54[b]	42.10[b]	0.22
Feed conversion ratio (g feed/g gain)	2.27[a]	2.36[a]	3.15[b]	3.38[b]	0.26
Feed cost (₦/Kg)	72.28	68.98	66.78	64.58	0.39
Cost of production(₦/Kg broiler)	164.08	162.79	210.36	218.28	-

SEM: Standard Error Mean
Av = Average,
₦ - Naira sign (Nigeria Currency symbol)
abc - Means across the same row differently superscripted differ significantly ($P<0.05$).

No mortality was recorded and no chick was observed debilitated during the investigation. However, there is need for genetic engineering to select against the gene/s responsible for the presence of calcium oxalate in yams and cocoyam - the chemical compound that itches and which hinders yam-tubers and cocoyam corms from being used raw in feed formulation.

The cost of production (N/Kg broiler) also followed similar pattern as feed cost. There was arithmetic difference but no statistical significant difference ($P>0.05$).

Conclusion and Application

1. Yam tuber peel is a possible recyclable feed material which, when developed into feed and fed to broiler starter chicks, the droppings from the birds can be applied to yam-tuber farm as organic fertilizer.
2. In all the inclusion levels in this investigation in which the yam tuber peel meal was applied to, no negative effect on performance of the broiler starter chicks was observed. It revealed that yam tuber peel would be a good source of energy substitute for maize in broiler starter feed.
3. Performance of broiler starter chicks fed yam tuber peel meal, peaked at 15% inclusion level. The study therefore suggests that 15% inclusion level of yam peel meal in broiler starter diet, could be the optimal level of inclusion.

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