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# Performance of Weaner Rabbits Fed Graded Levels of Yam and Sweet Potato Peel Meal in Place of Maize-Based Diet

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**Abstract:** Performance of weaner rabbits fed graded levels of yam and sweet potato peel meal in place of maize based diet was investigated using 20 weaner rabbits of average weight of 389 ± 55g. They were randomly allotted to 5 dietary treatment groups having 2 replicates with 2 rabbits per replicate in a completely randomized design. Diet I was maize based and served as control diet. The test ingredients replaced maize at 20%, 30 % 40% and 50 % in diets 2, 3, 4 and 5 respectively. The yam and sweet potato peel meals were combined in ratio 3:2.Each diet was offered *ad libitum* for a period of 56 days. The proximate composition and gross energy (G E) of the test ingredients are as follows: DM (89.74, 89.61), crude protein (6.34, 11.1) ether extract (1.3, 1.3), crude fibre (0.36, 7.20) ash (4.58, 10.17), nitrogen free extract (70.39, 77.13), and gross energy (3.21, 2.98). The anti-nutritional factors of the test ingredients are as follows: Tannin (0.60, 0.22 %), saponin (0.90, 0.67%), trypsin inhibitors (0.00, 0.00) and phytate (0.94, 0.74 %). There was no significant difference ($P>0.05$) for all the growth parameters considered except for feed intake. The values significantly ($P<0.05$) increased as the quantity of the test ingredients increased. The feed conversion ratio values (7.9900,7.2900, 7.4150, 6.5600 and 7.6550) numerically favoured diet 4. Carcass characteristics values showed significant difference for percentage dressed weight and drumstick only. The percentage dressed weight for all the treatment groups fell within the normal range of dressing percentage of rabbits. The drumstick values (4.7400, 5.0000, 7.4100, 7.6900 and 7.1400) favoured diet 4 among others. The weight of organs showed no significant difference among treatment groups except for the heart, values of which did not follow any specific pattern that could be attributed to the effect of the test ingredients. Biochemical values showed no significant difference except for the value of total protein; this and other biochemical parameters (total protein, urea, creatinine and alkaline phosphatase) fall within the normal range of biochemical indices for rabbits. Gross margin values (N780.6000, N1070.7350, N1061.0100, N1260.1430, N1148.0800) favoured diet 4 among others. Judging from growth performance, carcass characteristics, organ weights, biochemical indices and economics of the diet, diet 4 is recommended.

**Key words:** Performance, weaner rabbits, graded levels, yam and sweet potato peel meal, maize-based diet

## Introduction

The third world countries, including Nigeria, are afflicted with malnutrition, especially with regards to inadequate intake of various nutrients, such as protein and calories (Oluyemi and Ologhobo, 1998). Animal protein is obtained from various animals. One of such animals is the rabbit which is richer in protein (20.8%) and lower in fat (10.2%) than other meat species (Baymen, 1984).The rabbit's rapid rate of reproduction, with short gestation period of 28-32 days, has made its production a wise choice for Nigerians as a means of alleviating protein food shortages. The major hindrance to the production of these animals to satisfy the required protein needs of most Nigerians has been attributed to high cost of production of which feed cost is highly significant. Feed accounts for about 70-80% of the total cost of animal production (Akinmutimi , 2001). This has been attributed to escalating prices of conventional feed ingredients especially the energy sources such as maize, sorghum etc. (Akinmutimi, 2006). This has brought about the quest to search for alternative feedstuffs (Ijaiya and Awonusi, 2001).

Yam peels and sweet potato peels have been identified as alternative feedstuffs that can form major sources of energy in livestock and poultry feeds (Adeyemo and Borire, 2002). Sweet potato peel for example contains as much as 3.4 calories per gram (Jansen, 1989). The peels constitute about 10% of the yam or sweet potato tuber (Ijaiya and Awonusi, 2005). However, information on the combined use of these peels meal in rabbit feed, to replace maize based diet is yet to be reported. This forms the objective of the study.

## Materials and Methods

**Environment of Study:** The study was carried out at the Michael Okpara University of Agriculture, Umudike. Umudike bears the co-ordinates of 5° 28' North and 7° 31' East and lies on altitude of 122m above sea level. Its annual rainfall is about 2177m, with relative humidity of about 72% and temperature range of 12-36°C. Umudike is within the tropical rain forest zone. Umudike is a town in Umuahia of Abia State of Nigeria.

Table 1: Ingredient Composition of Experimental Diets

| Ingredient | D1 (0%) | D2 (20%) | D3 (30%) | D4 (40%) | D5 (50%) |
|---|---|---|---|---|---|
| Maize | 50.00 | 40.00 | 35.00 | 30.00 | 25.00 |
| Yam peel | - | 6.00 | 9.00 | 12.00 | 15.00 |
| Sweet potatoes peel | - | 4.00 | 6.00 | 8.00 | 10.00 |
| Soyabean meal | 16.00 | 16.00 | 16.00 | 16.00 | 16.00 |
| Palm kernel | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 |
| Fish meal | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Wheat offal | 9.50 | 9.50 | 9.50 | 9.50 | 9.50 |
| Bone meal | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 |
| Salt | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| Vitamin premix | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| Crude protein | 16.90 | 16.94 | 16.96 | 16.98 | 17.00 |
| ME (Kcal/kg) | 2788.00 | 2737.20 | 2711.97 | 2686.63 | 2661.28 |

To provide the following/kg feed: Vitamin A 5,000,000 IU, Vitamin D3 1,000,000 IU, Vitamin E 16.000mg, Vitamin K3 800mg, Vitamin B1 1,200mg Vatamin B2 22,000mg, Niacin 22,000mg Calcium pentothenate 4,600mg Vitamin B6 2,000mg ,Vitamin B12 10mg, Manganese 948,000mg, Folic acid 400mg, Biotin 32mg, Chlorine chloride 200,000mg, Iron 40,000mg, Zinc 32,00mg Copper 3,400mg, Iodine 600mg Cobalt 120mg ,Selenium 48mg, Anti-oxidant 48,000mg.

Table 2: Proximate composition of experimental diets and the test ingredients

| Constituents (%) | D1 | D2 | D3 | D4 | D5 | Sweet potato peel meal | Yam peel meal |
|---|---|---|---|---|---|---|---|
| Dry matter | 89.74 | 89.62 | 89.90 | 89.64 | 89.81 | 89.74 | 89.61 |
| Crude protein | 15.84 | 16.79 | 17.15 | 16.97 | 17.28 | 6.34 | 11.10 |
| Ether-extract | 3.51 | 3.57 | 3.63 | 3.71 | 3.73 | 1.30 | 1.30 |
| Crude fiber | 6.61 | 6.70 | 6.83 | 6.99 | 7.11 | 0.36 | 7.20 |
| Nitrogen free extract | 56.66 | 55.34 | 54.95 | 54.55 | 54.18 | 70.39 | 77.13 |
| Ash | 7.12 | 7.22 | 7.34 | 7.39 | 7.51 | 4.58 | 10.17 |
| Gross Energy (Kcal/g) | 3.03 | 3.03 | 3.04 | 3.05 | 3.06 | 3.21 | 2.98 |

Table 3: Anti-nutritional factors in yam and sweet potato peel meals

| Factors (%) | Yam peel | Sweet potato peel |
|---|---|---|
| Tannin | 0.6 | 0.220 |
| Saponin | 0.9 | 0.665 |
| Oxalate | 1.26 | 1.040 |
| Phytate | 0.94 | 0.740 |
| Trypsin inhibitor (TIU) | 0.00 | 0.000 |

**Experimental animals and management:** Twenty weaner rabbits of mixed sexes and breeds were used for the experiment. The weaner rabbits were of average weight of 389 ± 55g. The rabbits were randomly allotted to five dietary treatment groups. Each treatment had two replicates with two animals per replicate. Feed and water were given *ad-libitum*. The feeding trial lasted for 56 days.

**Processing of the test feedstuff:** The peels were collected within 12 hours of disposal from fast food restaurants within the metropolis and were sun dread, milled and kept for feed formulation and analysis.

**Experimental diets:** There were five treatment diets with diet 1 serving as control diet. While the test ingredients replaced maize at 20, 30, 40 and 50% in diets 2, 3, 4 and 5 respectively. The yam and sweet potato peel meals were combined in the ratio of 3:2.

**Chemical and statistical analysis:** The test ingredients and diets were analyzed for proximate composition and gross energy according to A.O.A.C (1990). The test ingredients were analyzed for anti-nutritional factor such as tannin, saponin, oxalate, phytate, trypsin inhibitor, using the method of A.O.A.C. (1990). The experiment was carried out in complete randomized design. The data was subjected to analysis of variance (ANOVA) as described by Steel and Torrie (1980), Separation of significantly different means was carried out using Duncan's Multiple Range Test as described by Duncan (1955).

**Parameter evaluated**

**Growth performance:** Data were collected on the initial and final weights of the animals, quantity of feed given and refusal, during the experiment.

The values obtained were used to calculate;

**Daily weight gain per rabbit/day (g)**

$$\frac{\text{Final live weight} - \text{Initial weight}}{\text{Number of rabbits X 56 days}}$$

**Feed intake /rabbit /day (g)**

$$\frac{\text{Quantity of feed given} - \text{left over}}{\text{Number of rabbits X 56 days}}$$

$$\text{Feed conversion ratio} = \frac{\text{Quantity of feed consumed}}{\text{Weight gain}}$$

Table 4: The mean values for growth performance of weaner rabbits fed experimental diets

| Parameters | D1 | D2 | D3 | D4 | D5 | SEM |
|---|---|---|---|---|---|---|
| Initial weight (g) | 275.00 | 455.000 | 400.000 | 430.000 | 418.750 | 135.0660 |
| Final weight (g) | 781.25 | 1025.000 | 1018.750 | 1190.625 | 1067.500 | 182.5225 |
| Weight gain/rabbit/day(g) | 9.04 | 10.175 | 10.870 | 13.585 | 11.940 | 1.7108 |
| Feed intake/rabbit/day(g) | 65.93$^{d}$ | 74.220$^{c}$ | 80.080$^{b}$ | 87.890$^{a}$ | 89.125$^{a}$ | 1.1766 |
| Feed conversion ratio | 7.99 | 7.290 | 7.415 | 6.560 | 7.660 | 1.2202 |

Gross margin/profitability of the diets were determined using Sonaiya *et al*. (1986) method.

**Carcass assessment:** The carcass quality was examined using Ojewola and Longe (1999) method. This involved the selection of two rabbits from each treatment that were closest to the treatment mean weight of the replicate. The selected rabbits were starved overnight and thereafter bled by severing the jugular vein.

The skin was removed by flaying; the head and feet cut off. Each rabbit was eviscerated, the internal organs collected weighed separately and was expressed as a percentage of dressed weight. The fore arms were removed by cutting interiorly, severing at the humero-scapular joint, the cut being made close to the body line. Lateral cuts were made, to separate the thighs, drumsticks, back cuts, shoulders from each carcass. These were weighed and expressed as percentage of dressed weight.

**Biochemical indices/ serum chemistry:** Serum chemistry samples were collected into sample bottles without anticoagulants.

Serum protein, urea etc were analyzed as described by Morbert (1979).

## Results and Discussion

The proximate composition for the experimental diets and the test ingredients is as shown in Table 2.

The determined values were closely related to the calculated values, and they all fall within the nutrient requirement of rabbits especially the crude protein and the energy values. The determined crude protein values for yam and sweet potato peel is in line with earlier reports of Akinmutimi *et al*. (2006) who reported 11.21% for yam peel, and Ajala (2001) who reported 6.37 for sweet potato peel.

The gross energy values of 2.985 and 3.21kcal/g respectively for sweet potato peels and yam peels reveals their potential as alternative energy sources for maize in rabbit production.

Table 3 reveals the anti-nutritional factors both in yam and sweet potato peel meals. The presence of these anti-nutritional factors confirms the reports of earlier workers, Udoessien and Ifon (1990); Osagie (1998) who reported in similar vein.

Table 4 shows the mean values for growth performance of weaner rabbits fed experimental diets.

There was no significant (P<0.05) difference for all the parameters evaluated with the exception of feed intake per rabbit per day. The feed intake values, increased significantly (P<0.05) as the quantity of the test ingredients increased in the diets. This significant (P<0.05) increase in feed in take could be due to lower metabolizable energy value of the test diets and hence increase in feed intake to meet the energy requirement of the animals (Enwenro and Udedibe 1998; Akinmutimi *et al*., 2006).

The feed conversion ratio favoured diet 4 numerically, although they are statistically similar. This makes diet 4 a better diet than all, since lower value of feed conversion ratio, shows superiority of the diet (Ogbonna *et al*., 2002).

There was no significant (P<0.05) difference for all the parameters measured expect for percent dressed weight and drumstick values.

Although there was significant (P<0.05) difference among the diets, they all fall within the normal range of dressing percentage of rabbit (50-57%) as was reported by Aduku and Olukosi (1990). This implies that the treatments had good edible parts (Akinmutimi, 2004).

The drumstick value favoured diet 4 followed by diet 3 and then control diet being the least. This makes diet 4 a more economic diet, drumstick being a prime part (Akinmutimi, 2004). This shows the superiority of Diet 4 to others.

Table 6 shows mean weights of internal organs expressed as percentage dressed weight.

There was no significant (P>0.05) difference for all the parameters considered expect for the heart. The heart did not follow a specific pattern that could be attributed to the effect of the diet. This implies that any of the diets could be selected. It is believed that, if there is any major effect of anti-nutritional factors, organs like liver and kidney should be significantly (P<0.05) affected being the major detoxification organs (Ukachukwu, 2000; Akinmutimi, 2004). This also confirms the earlier statement that the anti-nutritional factors in the test ingredients are within a tolerable level.

Table 7 shows the mean biochemical values of weaner rabbits fed control and experimental diets.

There was no significant (P<0.05) difference for all the parameters considered with the exception of total protein. All the parameters considered fall within the normal range of biochemical indices for rabbits (Van Praag, 2004). This also confirms that the anti-nutritional factors in the test ingredients are still within a safe level as earlier observed.

Table 5: Mean weight of carcass characteristics expressed as percentage dressed weight

| Parts | D1 | D2 | D3 | D4 | D5 | SEM |
|---|---|---|---|---|---|---|
| Drumstick | 4.740$^{e}$ | 5.00$^{d}$ | 7.41$^{b}$ | 7.6900$^{a}$ | 7.140$^{c}$ | 0.9447 |
| Forearm | 2.275 | 1.84 | 2.09 | 1.9400 | 2.550 | 0.7103 |
| Thigh | 18.205 | 18.75 | 18.52 | 26.2800 | 20.190 | 4.4310 |
| Shoulder | 9.105 | 9.00 | 10.91 | 10.4600 | 11.125 | 1.2890 |
| Back cut | 33.330 | 32.50 | 33.33 | 34.6200 | 30.770 | 1.1180 |
| Breast cut | 3.325 | 4.00 | 3.70 | 3.9075 | 3.850 | 0.4213 |
| % dressed weight | 51.720$^{e}$ | 55.56$^{b}$ | 56.25$^{a}$ | 52.0000$^{d}$ | 53.850$^{c}$ | 0.0224 |

Table 6: Mean weight of internal organs expressed as percentage dressed weight

| Parts | D1 | D2 | D3 | D4 | D5 | SEM |
|---|---|---|---|---|---|---|
| Spleen | 0.1100 | 0.0700 | 0.1300 | 0.0800 | 0.4000 | 0.0000 |
| Lung | 1.3600 | 1.1250 | 1.2000 | 1.3700 | 1.0800 | 0.1304 |
| Kidney | 1.7300 | 1.5950 | 1.8400 | 1.5150 | 1.7800 | 0.2012 |
| Heart | 0.5800$^{b}$ | 0.4000$^{e}$ | 0.5100$^{c}$ | 0.4450$^{d}$ | 0.7200$^{a}$ | 0.0000 |
| Liver | 4.9850 | 4.6300 | 4.9900 | 5.3050 | 6.5050 | 0.8479 |

Table 7: Mean biochemical values of weaner rabbits fed experimental diets

| Parameters | D1 | D2 | D3 | D4 | D5 | SEM |
|---|---|---|---|---|---|---|
| Total protein | 50.0$^{b}$ | 56.0$^{b}$ | 56.0$^{a}$ | 57.0$^{a}$ | 54.5$^{b}$ | 0.671 |
| Urea | 34.5 | 40.0 | 40.0 | 36.0 | 40.0 | 3.585 |
| Creatinine | 0.5 | 0.5 | 0.5 | 0.5 | 0.6 | 0.045 |
| Alkaline phosphatase | 58.0 | 70.0 | 64.5 | 65.0 | 59.0 | 4.249 |

Table 8: Mean values of the economics of experimental diets

| Parameters | D1 | D2 | D3 | D4 | D5 | SEM |
|---|---|---|---|---|---|---|
| Cost /kg feed /N | 42.9750$^{a}$ | 38.3300$^{b}$ | 36.0100$^{c}$ | 34.2500$^{d}$ | 31.3800$^{e}$ | 0.0000 |
| Cost of feed consumed (N) | 158.6470$^{ab}$ | 159.2635$^{ab}$ | 161.4900$^{ab}$ | 168.5725$^{a}$ | 156.9850$^{b}$ | 2.6317 |
| Revenue (N) | 937.5000 | 1230.0000 | 1222.5000 | 1428.7500 | 1305.0000 | 219.0270 |
| Gross margin (N) | 780.6000 | 1070.7350 | 1061.0100 | 1260.1430 | 1148.0800 | 218.9810 |

The economics of the diets is as shown in Table 8. There were significant ($P<0.05$) differences for cost /kg of feed and cost of feed consumed. Cost per kg of feed favoured diet 5. This may be due to the prices of the test ingredients. The cost of feed consumed also favoured Diet 5. This may be due to effect of the cost of kg of feed. Although the gross margin values did not differ significantly ($P<0.05$), numerically it favoured Diet 4 (40% inclusion of yam and sweet potato peels). This may be the product of moderate good weight gain and good revenue (Akinmutimi, 2004)

**Conclusion:** Judging from growth performance, carcass characteristics, organ weights, biochemical values and economics of the diet, diet 4 (30 % replacement of maize) is recommended

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