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Response of Weaner Rabbits Fed Graded Levels of Sweet Potato Meal in Place of Maize-Based Diet

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Abstract: Performance of weaner rabbits fed graded levels of sweet potato peel meal in place of maize-based diet was investigated. 24 weaner rabbits aged between 5-7 weeks and of equal live weight were randomly allocated to 4 dietary treatments. Each treatment having 3 replicates of 2 rabbits per replicate in a completely randomized design (CRD). Diet 1 was maize based, which served as control and the test feedstuff (sweet potato peels) quantitatively replaced 5 (11.11%) 10 (22.22%) and 15 (33.33%) of maize meal in diets 2, 3 and 4 respectively. Each diet was offered ad libitum for a period of 56 days. The proximate composition of the test ingredient is as follows: Dry matter - 89.74%, Crude protein 6.34%, Ether extract 1.37% C.F 0.36%, Ash 4.58%, NFE 87.42 and Gross energy 3.214. The anti nutritional factors of the test ingredient are as follows: Saponin 0.67%, Oxalate 1.08%, Tannin 0.22% phytate 0.74% and Trypsin inhibitor 0.00. There was significant ($P<0.05$) difference for growth parameters considered among the diets. Diet 2 had the highest weight gain of 10.4267 as against 8.8367, 9.5300 and 8.2700 for diets 1, 3 and 4 respectively, and the least feed conversion ratio of 7.4733 as opposed to 8.8100, 9.0467 and 10.9867 for diets 1, 3 and 4 respectively. There were significant ($P<0.05$) differences for the values obtained for cut parts. The result favoured diets 1 and 2 when compared to others. However, diet 2 had the highest values for the prime parts (thigh, drumstick, shoulder, breast cut and back cut). The values of the organs showed significant ($P<0.05$) difference with the exception of lung and spleen. For haematological and serum chemistry (Hb, PCV, RBC, WBC, lymphocytes, neutrophil, eosine, MCV, MCHC, MCH, creatinine and alkaline phosphates), values obtained fall within the normal range of haematological and biochemical indices for rabbits. For gross margin, diet 2 had the highest value (N227.4600) when compared with the control diet (N147.5800), diet 3 (N178.4500) and diet 4 (N174.1000) making diet 2 a choice diet. Judging from growth performance, carcass characteristics, organ weights, haematological and biochemical values and economics of the diets, diet 2 is recommended.

Key words: Weaner rabbits, sweet potato, peel meal, maize-based diet

Introduction

Rabbits are found in many different continents and climatic zones and it has been estimated by the World's Statistics at 709 million, about 50 and 30 percentage of this figure are found in Africa and Nigeria respectively (Lukefahr, 1990).

Rabbits are unique animals. They serve as a flexible financial reserve for rural population and as well play other socio-cultural roles in the customs and traditions of many Nigerian Societies. The prolific nature of rabbits coupled with its short gestation period and generation interval, makes it the animal of choice for multiplication and a short way of increasing animal protein intake (Akinmutimi *et al*., 2006).

Feed is one of the major problems of intensive rabbit production in Nigeria due to the competition between man, animal and industries for conventional feed materials. This has led to the escalating cost of conventional feed ingredients and has made feed cost to account for about 70% of total cost of production (Akinmutimi, 2004). This problem has been the prime stimulants for the continuous search for alternative feedstuffs that can meet the nutritional requirements of micro-livestock, reduce the cost of feed and animal production (Olorede *et al*., 2002).

Such a feedstuff should be one that has very low human food preference and of low industrial usage (Olorede *et al*., 2002).

The answer may lie in the use of farm or agro by-products such as sweet potato peels.

Sweet potato is a staple food in Nigeria, it ranks fourth in production and importance after, cassava, yam and cocoyam (Ikwelle *et al*., 2003). The production level of sweet potato was 2.5 metric tonnes in the year 2004 (FAO, 2005) which some fractional part constitute the peels. Tewe (1997) projected that the crop residue from sweet potato peels will be 4.72 metric tones, as of the year 2000. The peels are good sources of quality plant carbohydrate. It contains about 6.3% crude protein and metabolizable energy of about 3411kcal/kg (Oyenuga, 1968; Jansen, 1989).

The objective for this study is to determine optimal

Table 1: Experimental diets

Ingredients	T1 0%	T2 11.11%	T3 22.22%	T4 33.33%
Maize	45.00	40.00	35.00	30.00
Sweet potato peels	0.00	5.00	10.00	15.00
Soybean meal	17.00	17.00	17.00	17.00
PKC	20.00	20.00	20.00	20.00
Wheat offal	13.50	13.50	13.50	13.50
Fish meal	1.00	1.00	1.00	1.00
Bone ash	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25
VMP	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Calculate Analysis				
Crude protein	17.58	17.45	17.31	17.18
ME(Kcal/kg)	2717.75	2716.60	2715.45	2714.30

1 Kg of premix contains vitamins A (5,000,000 I.u), vitamins D3 (1,000,000 i.u), vitamins E (16,000mg), vitamins K3 (800mg), vitamins B1 (1,200mg), vitamins B2 (22,000mg), Niacin (22,000mg), Calcium pentothenate (4,600mg), Vitamins B6 (2,000 mg), vitamin B12 (10mg), Folic acid (400mg), Biotin (32mg), Choline chloride (200,000mg), Manganese (948,000mg), Iron (40,000mg), Cobalt (120mg), Zinc (32,000mg), Copper (3,400mg), Iodine (600mg), Selenium (48mg), Anti-oxidant (48,000mg).

dietary level of inclusion of raw sweet potato peel meal as a substitute for maize in weaner rabbits diet.

Materials and Methods

Environment of study: The study was carried out at Michael Okpara University of Agriculture Umudike Teaching and Research Livestock Farm. The area is located within the tropical rainforest zone. It is characterized by an annual rainfall of sabout 2177mm high relative humidity of above 72% at the rainy season, monthly temperature of about 17 to 36°C with the highest average range of 22-30°C at the month of March. The environment lies at the latitude of 5° 28 North and 7° 31' East, altitude of 122m above sea level.

Housing: The experimental rabbits were housed in hutches located inside the rabbitory building. Each hutch had a feed and water trough for concentrates and water respectively. The building is made of asbestos roofing and long windows this is to facilitate proper ventilation and proper dissipation of heat as fast as possible.

The animals and their management: A total of twenty-four (24) rabbits of mixed breeds, aged between 5-7 weeks and of equal live weight were selected for this trial. The rabbits were housed in individual cages for one week for adaptation. After the adaptation period, the rabbits were randomly divided into four (4) treatment groups. Each treatment group had three (3) replicates with two (2) rabbits per replicate. The rabbits were fed *ad- libitum* for 56 days. Feed intake and weight gain were determined for this period.

Test feedstuff and diets: The sweet potato peels were collected from the surrounding environment. It was sun dried and milled before it was used for chemical analysis and formulation of diets. Four diets were formulated and fed *ad-libitum* to the 24 rabbits. All the diets contained soybean meal, palm kernel cake and fishmeal as major ingredients. Sweet potato peels meal was used to replace maize meal at (0%), 5 (11.11%), 10 (22.22%) and 15% (33.33%) in diets 1, 2, 3 and 4 respectively.

Parameters evaluated

Growth performance: Data were collected on initial and final weights of the animals, feed given, the left over and the number of animals that died during the experiment in each replicate. The values obtained were used to obtain the following parameters

$$\text{Feed Intake} = \frac{\text{Quantity of feed given} - \text{Left over (g)}}{\text{number of rabbits X 56 days}}$$

$$\text{Daily weight gain/rabbit} = \frac{\text{Final weight} - \text{Initial weight}}{\text{number of rabbits X 56 days}}$$

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

$$\% \text{ mortality} = \frac{\text{Number died}}{\text{number purchased}} \times \frac{100}{1}$$

Gross margin: This reveals the profitability of the diets. Gross margin was calculated using the method of Sonaiya *et al.* (1986).

Evaluation of carcass quality / organ weight: Evaluation of carcass quality was carried out as described by Akinmutimi *et al.* (2006). This involves the random selection of two rabbits from each treatment group. The selected rabbits were fasted over night to clear the gut before slaughtering. The prominent body parts such as the thigh, drumstick, forearm, shoulder, breast cut and back cut were separately weighed. The internal organs such as the lungs, heart, spleen, kidney and the liver were also weighed and both expressed as percent of the dressed weight.

$$\frac{\text{Organ/cut-part weight}}{\text{Dressed weight}} \times \frac{100}{1}$$

Haematology and biochemical indices: Two rabbits per treatment were selected, starved overnight and slaughtered by severing the jugular vein for blood collection. Blood samples were collected separately from each animal .into bottles containing EDTA for haematological parameters (Hb, PCV, WBC and RBC) and universal bottles without anticoagulant for biochemical indices. These samples were analyzed for haematological parameters according to Dacie and Lewis (1991) and for biochemical studies according to Morbert (1979).

Table 2: Proximate Composition of the Diets And Test Ingredient

	T1 (0%)	T2 (11.11%)	T3 (22.22%)	T4 (33.33%)	Test ingredient
Dry matter	89.630	89.57	89.420	89.620	89.740
Crude protein	16.790	17.06	17.190	17.190	6.340
Ether extract	3.510	3.68	3.760	3.800	1.300
Crude fiber	5.550	5.68	5.750	5.860	0.360
Ash	6.610	6.81	6.950	6.990	4.580
Nitrogen free extract	57.170	56.34	55.770	55.780	77.160
Gross energy	3.049	3.056	3.076	3.081	3.214

Table 3: Percentage anti-nutritional factors in sweet potato peel meal

Anti-nutritional factors	Percentage
Saponin	0.67
Oxalate	1.08
Tanin	0.22
Phytate	0.74
Trypsin inhibitor	0.00

Chemical and statistical analysis: The experiment was carried out in a completely randomized design (CRD). 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).

The four treatment diets were analyzed for proximate composition and gross energy according to (AOAC, 1990). The test ingredient (sweet potato peels) were also analyzed to determine the levels of anti-nutritional factors such as oxalate, tannin, saponin and trypsin inhibitor at the Institute of Agricultural Research and Training (IAR & T) Ibadan according to AOAC (1990).

Results and Discussion

Table 2 shows the proximate composition of experimental diets and the test ingredient. The value of crude protein determined for the diets fall within the range of the nutrient requirements for weaner rabbits (Akinmutimi, 2006). They were closely related to the calculated ones. The crude protein value (6.34%) obtained for the test ingredient is in line with the earlier reporter, Ajala (2001). The energy value of 3.21kcal/g makes it a potential substitute for maize.

Table 3 shows the anti-nutritional factors present in sweet potato peel meal. This confirms the report of earlier researcher who reported presence of these anti-nutritional factors in sweet potato peel meal (Eka, 1977; Osagie, 1998).

The growth performance of weaner rabbits fed sweet potato peel meal in place of maize- based diet is as represented in Table 4.

There was significant ($P<0.05$) difference for all the parameters considered.

The final live weight observed shows that diet 2 was significantly ($P<0.05$) higher than diets 1, 3 and 4. Although diets 1, 3 and 4 were statistically similar but differ numerically with diet 1 having the least value. This implies that even at 15% dietary level of inclusion the effect of anti-nutritional factors is within a tolerable level (Ologbobo *et al.*, 1993; Akinmutimi, 2004).

There was progressive increase in the value of feed intake as the quantity of the test ingredient increased in the diet. It became significant ($p<0.05$) from the control diet at 15% dietary level of inclusion (diet 4). This may be due to slight lower energy value of the diets containing the test ingredient and hence increase in feed intake to meet their energy requirement (Akinmutimi, 2004; Akinmutimi *et al.*, 2006).

For the weight gain, the control diet was statistically similar to the test diets. Diet 2 differed significantly from diet 4. The downward trend observed from diet 2 to diet 4 could be attributed to the effect of anti-nutritional factors becoming more pronounced as the quantity of the test ingredient increased.

Saponin an anti-nutritional factor in the test ingredient (Table 3) for example has been reported to cause decrease in daily weight gain through binding to the cell of the small intestine thereby affecting the absorption of nutrients across the intestinal wall (Olumu, 1995; Akinmutimi, 2004).

The feed conversion ratio values observed shows that the control diet is not significantly ($P<0.05$) different from the test diets but the slightly higher numerical values obtained for diets 3 and 4 could be attributed to poor nutrient utilization as a result of increased effect of anti-nutrients as the quantity of the test ingredient increased in the diet.

The 0% mortality confirms that the effect of anti-nutrient is within a tolerable level. The growth performance result showed that diet 2 is the choice diet judging from good feed intake, better weight gain and having the least value for feed conversion ratio when compared with other diets.

Table 5 shows the carcass characteristics of weaner rabbits fed sweet potato peel meal in place of maize-based diet.

There were significant ($P<0.05$) differences for all the parameters considered. The result favoured diets 1 and 2 when compared to others. Considering the prime parts such as thigh, drumstick, shoulder, breast-cut and back-cut, both statistically and numerically diet 2 is more favoured.

The result of organ weight of weaner rabbits fed sweet potato peel meal in place of maize-based diet is as

Table 4: The growth performance of weaner rabbits fed sweet potato peel meal in place of for maize-based diet

Parameters	T1	T2	T3	T4	SEM
Initial weight(g)	880.0000	885.0000	832.6667	837.6667	54.0352
Final weight(g)	1175.0000^{b}	1487.5000^{a}	1306.2333^{b}	1325.0000^{b}	45.5364
Weight gain/rabbit/day(g)	8.8367a^{b}	10.4267^{a}	9.5300^{ab}	8.2700^{b}	0.5670
Feed intake/rabbit/day(g)	75.9400$_{b}$	77.9167^{b}	83.0700^{b}	90.8467^{a}	2.3462
Feed conversion ratio(g)	8.8100^{ab}	7.4733^{b}	9.0467^{ab}	10.9867^{a}	0.7650
Percent mortality (%)	0.0000	0.0000	0.0000	0.0000	0.0000

Table 5: Carcass Characteristics Of Weaner Rabbits Fed Sweet Potato Peel Meal in place of Maize- Based Diet

Parameters	T1	T2	T3	T4	SEM
Thigh	29.9600^{ab}	33.7000^{a}	29.9933^{ab}	29.5600^{b}	1.1410
Drumstick	7.2767^{ab}	8.3300^{a}	6.8400^{ab}	4.8933^{b}	0.7966
Forarm	3.8000^{a}	3.4800^{a}	2.2533^{b}	0.9033^{c}	0.3595
Shoulder	29.9600^{a}	29.6200^{a}	19.9333^{b}	20.4300^{b}	0.6562
Breast cut	6.7867^{a}	6.7533^{a}	4.8800^{b}	4.2200^{c}	0.1913
Back cut	18.4667^{b}	26.3833^{a}	23.3133^{ab}	18.6900^{b}	1.7776
Life weight	1112.5000^{ab}	1375.000^{a}	1025.0000^{b}	1362.5000^{a}	97.2271
Dressing percentage	60.7400^{a}	57.4700^{ab}	55.0400^{b}	54.8000^{b}	1.2629

Table 6: Organ weight of weaner rabbits fed sweet potato peel meal in place of maize-based diet

Organs	T1	T2	T3	T4	SEM
Lung	1.0500	1.2200	1.3100	1.35	17.3257
Liver	4.5133^{c}	4.5100^{c}	4.9700^{b}	5.2600^{a}	0.0244
Kidney	1.4067^{c}	1.4933^{b}	1.2933^{d}	1.5800^{a}	0.0173
Heart	0.5100^{b}	0.4000^{c}	0.6300^{a}	0.3837^{c}	0.0000
Spleen	0.3433	0.2633	0.2433	0.2733	0.0447

Table 7: The heamatological values and some biochemical indices for weaner rabbits fed sweet potato peel meal in place of maize-based diet

Parameters	T1	T2	T3	T4	SEM
Hb (g/dl)	10.5000^{NS}	10.5500^{NS}	9.2000^{NS}	8.5500^{NS}	0.5912
PCV (%)	33.0000^{b}	38.0000^{a}	27.5000^{c}	25.5000^{d}	0.2039
RBC (mm^2)	5.4867^{a}	4.7000^{ab}	4.4000^{b}	4.1000^{b}	0.3026
WBC	4.1500^{b}	5.0500^{b}	9.2500^{a}	11.4000^{a}	1.0258
Neut (%)	66.0000^{a}	57.5000^{ab}	62.0000^{ab}	44.1667^{c}	2.4971
Lymph (%)	23.0000^{bc}	38.0000^{b}	32.0000^{ab}	48.5000^{a}	2.5860
Eosine (%)	11.0000^{a}	4.5000^{b}	6.0000^{b}	4.0000^{b}	1.0508
MCV(µm3)	58.7100^{b}	72.2200^{ab}	66.6600^{ab}	109.8200^{a}	13.5954
MCH (g/dl)	19.5233^{b}	23.8800^{ab}	20.9600^{b}	36.7833^{a}	4.5866
MCHC (%)	33.3133^{ab}	32.9800^{b}	33.4533^{a}	33.5300^{a}	0.1195
Creatinine (mg/dl)	0.5000^{b}	0.5000^{b}	0.6000^{b}	1.2500^{a}	0.1612
Alkaline phosphorus	63.0000^{c}	58.0000^{d}	66.0000^{b}	88.0000^{a}	0.1048

Table 8: The economics of the diets

	T1	T2	T3	T4	SEM
Cost/kg of feed	32.14720	32.98800	31.8288	30.6696	0.0000
Cost of feed consumed	144.92000	143.79000	147.8000	155.9000	4.4524
Revenue	292.5000^{b}	371.2500^{a}	326.2500^{b}	330.0000^{b}	11.5131
Gross margin	147.5800^{b}	227.4600^{a}	178.4500^{b}	174.1000^{b}	14.8751

revealed in Table 6. There were significant ($p<0.05$) differences for all parameters considered except for lung and spleen.

The values of kidney and heart did not follow any specific pattern that could be attributed to the effect of test ingredient. The value of the liver became significantly ($P<0.05$) different for diets 3 and 4 when compared with control diet. This could be attributed to the effect of anti-nutritional factors present in the test diet. Liver being a major detoxification organ and hence increasing in weight as a result of increased activity to detoxify the anti-nutritional factors (Akinmutimi, 2004; Akinmutimi *et al.*, 2006).

The above result strengthened the choice of diet 2.

The haematological values and some biochemical indices for weaner rabbits fed sweet potato peel meal in place of maize-based diet is as presented in Table 7, there were significant difference ($P<0.05$) in all the parameter considered, although, they all fell within the normal range of heamatological values for rabbits as

reported by Van Praag (2004). This implies that the anti-nutritional factors present in test diets is still within a tolerable level.

The creatinine value shows that diet 1, 2 and 3 are statistically similar to one another but differ significantly from diet 4. Despite this, they all fall within the normal range of biochemical indices as established by Vaan Praag (2004). This still implies a tolerable level on the anti-nutritional factors present in the test ingredient and hence the animals are not living on their body reserve (Akinmutimi, 2004; Adeyemo *et al*., 2000).

The alkaline phosphatase values for all the diet did not follow a specific pattern that can be attributed to the effect of the test ingredient, although they all fall within the normal range as established by Vann Praag (2004). This confirms a tolerable effect of the anti-nutritional factors present in the test ingredient.

The economics of the diet is as shown in Table 8.The cost per kilogram of feed and cost of feed consumed did not differ from one another for the diets. The values for revenue and gross margin showed significant ($P<0.05$) difference for the diets. Diet 2 had values that were significantly ($p<0.05$) higher than other diets making it a most profitable diet among the diet and hence a choice diet.

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