THE USE OF YAM PEEL MEALS (YPM) AS A SOURCE OF ENERGY IN CONCENTRATE DIET FOR RABBITS

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Abstract

An eight-week feeding trial was conducted to determine the use of yam peel meal as a source of energy in concentrate diets for feeding rabbits. Thirty cross bred rabbits (Chinchilla and New Zealand white) of different age ranging from 2-3 weeks with average initial weight of 1550500g were used. The final weight ranged from 1300.00 to 1846. 333g. The rabbits were randomly allocated into five treatment groups in a Randomized Complete Design. Each treatment was replicated three times having two rabbits per replicate. five experimental diets were formulated with yam peel meals at varying levels of replacement. The replacement levels of yam peels were 0%, 5%, 10%,20% and 30% representing T_1, T_2, T_3, T_4, and T_5 respectively. Each of the diets was offered ad-libitum to the rabbits. Parameters measured include, feed intake, body weight, body weight gain, feed conversion ratio, carcass characteristics and cost benefits analysis. Carcass analysis was done at the eight weeks and Cost implication of the experiment with yam peels calculated at the end of the experiment. There were significant ($p<0.05$) difference among treatments groups for daily weight gain, carcass characteristics and daily feed intake. No significant ($p>0.05$) difference in fasted weight and singed weight, bled weight were observed. However, significant ($p<0.05$) difference among treatment groups for fore limbs, large intestine, loin, feet, neck, hearts, and abdominal fats were observed. The cost benefits analysis of feeding graded levels of yam peel meal to growing rabbits indicate that maximum benefit can be obtained at 30% level of yam peel meal inclusion without adverse effects on the growth performance of rabbits. Rabbit's game enterprise requires minimum capital investments and the demand for the products is high. Rabbits provide white meat proteins source which is desired especially among aged people. Rabbits are raised with forage and this study has proved that they can be raised using kitchen waste such as the yam peel. Therefore, rabbitary provides opportunity for kitchen waste recycling of yam peels.

Key words*:* Yam peels meals (YPM), Concentrate Diets, Rabbits.

Introduction

Rabbits (*Oryctolagus cuniculus*) descended from wild rabbits found in the Mediterranean countries and was introduced into England in the late eleventh to early twelfth century (Aduku and Olukosi, 1990). The Nigerian wild hares which are mostly grayish brown in colour are still very common. According to Aduku and Olukosi, (1990), in early 1960's United States Department of Agriculture (USDA) was involved in introducing more rabbits to Western states of Nigeria and between 1988 and 1989, Directorate of Food, Road and Rural Infrastructure (DIFRI) was involved in encouraging importation of exotic rabbit breeds. After the Biafran war, in Nigeria, rabbits were used in parts of the

country to produce meat quickly, to help in the nutrition of those that had lost their crops and animals (Denis1991).

Rabbit is known in Nigeria in local languages as Zomo (Hausa), Ewi (1bo), and Ehoro (Yoruba). It is 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 is in Africa and Nigeria respectively (Lukefahr, 1990). They serve as a flexible financial reserve for rural population as well as play other socio-cultural roles in the customs and traditions of many Nigerian societies (Akinmutimi and Osuagwu, 2008). 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.(Uchewa, et al 2014).Domestic rabbits are ubiquitous, providing protein, fibre, research models, and companionship. The rabbit industry is growing in many countries in Africa today, hence, feeding problems associated with poultry and pig farming are now being encountered by rabbit breeders who depend solely on pellets and concentrates for their animals. There is therefore an urgent need to develop rabbit production. Exotic rabbits are assuming prominence in an effort to alleviate the supply demand of animal protein in Nigeria. The extent to which such effort succeed will depend on how well local and other management practice can be put in place to ensure optimum performance. However, careful management and balancing of diets is necessary (Uchewa et al., 2014).Yam peels have been widely and successfully used as conventional energy source for livestock. There is the need, therefore to explore the use of non- conventional feed resources that have the capacity to yield the same output as conventional feeds perhaps at cheaper cost. Hence, any similar high energy ingredient which could partially or completely replace maize. This strategy could help in reducing the cost of production thereby making available the major crops for human consumption. The production of least cost diet using cheaper and unconventional feed resources is an important aspect of commercial rabbit production. (Vasanthakumar etal., 1999; and Muriu etal., 2002). One possible source of cheap energy is the yam peels. (*Dioscorea rotundata)* farm wastes that has such potentials (Adeyemo and Borrie,2002).

Yam peel is cheaply available in Nigeria (Uchewa *et al.,*2014) Yam peels consist of 11% crude protein with metabolizable energy of 2604kcal/g. (Eka,1985 and Akanno 1998). *rotundata* peels are rich in amino acid (Eka,1985). Yam peel as described by Akinmutimi and Anakebe (2008) contains 12.70% CP,6.30%CF and gross energy / kcal / g of 2.98. 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 problem has been the prime stimulants for the continuous search for alternative feed stuffs that can meet the nutritional requirements of livestock, reduce the cost of feed and animal production (Olorede *et al*., 2002). Such a feed stuff should be one that has very low human food preference and of low industrial usage (Olorede *et al.,* 2002). The solution may lie in the use of farm or agro by-products such as yam peels, cassava peels and sweet potato peels. The use of Yam peel meal for animal feed will help in reducing the competition between man and animal for the less available grains and will harness the efficient and effective use of yam peel waste. Yam peel is readily available in all the parts of Nigeria with little or no cost. It constitutes environmental hazard where it is not properly utilized. There is paucity of information on utilization of yam peel in the diet of rabbits

hence the feeding trial was conducted to use the yam peels as a source of energy in concentrate diet for feeding rabbits.

MATERIALS AND METHODS

Experimental Site

This study was conducted at the Rabbitry section of Dagwom Farm, National Veterinary Research Institute Vom. Vom is located in Jos-South Local Government Area of Plateau State. The site lies on latitude 8^{o} 43N and longitude 8^{0} 46'E. with an altitude of 1293.2m above sea level. Jos-South Local government area is one of the seventeen Local government areas in Plateau State of Nigeria. Jos south local government is made of four districts; Vwang, Du, Gyel and Kuru.The Local government area has its Headquarters in Bukuru which is located south of Jos-North Local government. It is bounded by Barkin-Ladi Local government to the South, Riyom Local government to the South west, Jos-east Local government to the East and Bassa Local government to the West. The Local government has a population of 650,835 with an average land area of 103km^2 (NPC 2006).

Determination of metabolizable energy (ME)

The ME value of diets and yam peels were determined with the ingredient. Substitution method (AOAC,2000). Using 8-week-old rabbits managed in standard wire cage. Yam peel was included to, comparatively, evaluate the ME of yam peel meal. At the beginning of the studies, the rabbits were divided into 5 groups on equal weight bases. Three rabbits were then randomly assigned to each of the five dietary treatments. There were five dietary treatments namely:

Diet 1which were serve as control (Table 1):
Diet 2 contained 5% level of yam, peel
Diet 3 contained 10% level of yam peel
Diet 4 contained 20% level of yam peel and
Diet 5 contained 30% level of yam peel

A three-day adaptation period was allowed for the rabbits to acclimatize with the cages and feed, followed by quantitative collection of total droppings at 24 hourly intervals. Feed and water were provided *ad libitum* during the period while avoiding spillages from the troughs. The feed for each group was weighed at the start and at the end of the of the collection period to determine feed intake during the trial. The droppings for each of the 3-day collection period per group were rid of extraneous materials weighed fresh, oven dried at 105^{o}C for 72hrs to content weigh before they were bulked and finely ground to obtained homogenous sample of the diet as well as yam peel were analysed for gross energy using a diabolic bomb calorimeter and nitrogen according to (A.OA.C,2000), procedure. The apparent metabolizable energy (AME) of the basal diets and substituted diets were calculated as follows:

$$\text{AME (kcal/kg)} = \text{GE of feed} - \text{GE of excreta}$$

Feed intake

Processing of yam peels

Yam peels were collected fresh from Kitchens and restaurants in Vom. The peels were dehydrated by sundrying for 7 days to reduce enzymatic and microbial reactions leading to spoilage and nutrient leaching. The sun drying was also aimed at enhancing the crispness and to reduce anti nutritional factors such as tannins, saponins, oxalate and phytate present in yam. The dry peels were then milled in a hammer mill before incorporating into the test diets.

Chemical Analysis of Yam Peel Meal

A sample of the test ingredient Yam Peel Meals (YPM) and experimental diets were collected and analysed for proximate composition and gross energy according to (A.O.A.C, 2000) at the Central Laboratory Unit of the Quality Assurance Grand Cereals Limited Jos.

Metabolizable energy was calculated using formula: ME= Metabolizable energy, calculated according to the formula of Ichaponami, (1980). ME (kcal/kg) = 432+27.91 (CP+ NFE +2.25 X EE).

Experimental Diet

The five experimental diets (Table2) were compounded using the following ingredients: maize, soya bean meal, maize offal, rice offal, wheat offal, yam peel meal, bone meal, limestone, salt and premix. Diet 1 (control) contain 0% of yam peel meal, in diets 2,3,4, and 5 included at 5%,10%, 20% and 30 % levels respectively.

Experimental Stock and management

A total of thirty (30) cross bred rabbits (chinchilla and New Zealand white) of mixed sex and age ranging from 2-3 weeks were purchased from Rabbit Section of Dagwom Farm National Veterinary Research Institute Vom and used for the experiment. They were randomly allocated to five treatments of three replicate each with two (2) rabbits per replicate. The rabbits were housed in cages measuring (width 35cm x 40cm length x 45cm height). The experimental diets and clean drinking water were provided *ad-libitum* throughout the experimental period of eight (8) weeks.

Productive parameters

The parameters assessed were: feed intake, body weight, body weight gain, carcass characteristic feed conversion ratio, and cost benefit analysis.

Feed intake

Feed consumption from each treatment was measured on daily basis by subtracting the left over from the served per group and adequate measure was taken to safeguard against spillage and wastage. The mean daily feed intake was calculated by dividing the quantity of feed consumed by the number of rabbit's present in the group.

Body weight

Rabbits were weighed individually (weekly) using an electronic digital weighing scale to determine their weights. The mean live weight of each treatment group was determined by dividing total weight by the total number of rabbits in the replicate.

Body weight gain

The body weight gain of rabbits in each replicate group was obtained by calculating the difference between the mean live weight of the current week from the live weight of the previous week divided by seven days in a week to obtain daily weight gain.

Feed conversion ratio

This was obtained on a weekly basis. It was measured by dividing the mean feed intake per rabbits in grams by the mean live weight gain per rabbit in grams for each treatment group.

$$\text{Feed Conversion Ratio} = \frac{\text{feed intake (g)}}{\text{body weight gain (g)}}$$

Cost benefit analysis

The cost – benefit analysis of the experimental diets was determined at the end of the study. The analysis was based on the market prices of the feed ingredients used during study period. The cost of each diet and the cost per kilogramme of weight gain by each rabbit was assessed. The price of each rabbit was also determined. The control was compared with the other diets to ascertain the cost benefits. (Olukosi, 2005)

Statistical Analysis

All data collected were subjected to analysis of variance (ANOVA) in line with the Complete Randomized Design (CRD) using the SPSS version 20.0 softwire computer statistical package. Significant differences among treatment means were compared using Least Significant Difference (LSD).

Results and Discussion

Proximate Composition of Yam Peels and the Experimental Diets

The results of the proximate composition of yam peels meal and the experimental diets are presented in Table 1: The yam peel had protein value of 9.83%, fat 1.16% calcium

0.60%, moisture 18.94%, Ash 9.06%, crude fibre 8.68% and metabolizable energy (ME) of 2280. /kcal/kg. The values reported here were similar to Uchewa, et al (2014) and Akinmutimi et al (2006). The crude protein, crude fibre, and ash in the diets ranges from 16.07 to 17.16, 8.88 to 9.36, 9.72 to 12.83 respectively. The value of the crude protein is in line with the recommended level of 18% for growing rabbits reared in the tropical countries as reported by (Martina and Damianan, 1983; Kellems and Church, 2006). This is an indication that the diets can support growth and development. The crude fibre value of 8.88 to 9.36% obtained in this study were below the values of 7.78 % as reported by Uchewa, et al (2014). In their work with yam peels replace of maize used in weaners rabbit diet. However, it met the level of 9% recommended by Lebas et al (1986) for normal growth and reduction of enteritis. Calcium, moisture ash value of 0.60 to 2.72, 9.06 to 12.83, 9.06 to 12.83% reported by Maertens, (1992).

Table 1: Percentage Composition of Experimental Diets and Yam Peel

Parameter	Treatment 1 (0%)	Treatment 2 (5%)	Treatment 3 (10%)	Treatment 4 (20%)	Treatment 5 30%)	Yam peels
% Protein	16.66	16.07	16.81	17.16	16.24	9.83
% Fat	5.74	4.81	4.23	3.60	3.47	1.16
% Calcium	1.39	2.44	2.30	2.72	1.64	0.60
% Moisture	13.48	13.00	12.39	14.17	13.82	18.94
%Ash	10.84	11.06	9.72	12.83	10.88	9.06
%Crude fibre	9.28	9.10	8.59	8.88	9.36	8.68
M. Energy (kcal/kg	2639.7	2604.0	2661.7	2442.2	2498.8	2280.1

Table 2: Ingredient composition and calculated Analysis of the experimental Diets containing yam peels

Treatments	T1	T2	T3	T4	T5
	0%	5%	10%	20%	30%
Ingredients					
Maize	40	39.5	39.5	35	30
Soybean	18	18.5	19	19	19
M/ offal	12	8	6	3	0
R/ offal	16	16.5	16.5	16	15
W/ offal	10	8.5	5	3	2
Yam peels	0	5	10	20	30
Bone meal	2.5	2.5	2.5	2.5	2.5
Limestone	1	1	1	1	1
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**	**100**
Calculated analysis					
CP (%)	15.58	15.65	15.62	15.63	15.74
CF (%)	9.02	9.09	9.06	9.28	9.35
ME	2519.40	2524.91	2528.18	2542.58	2526.53

**To provide the following per kg of feed: Vit. A, 10,000IU; Vit B1, 075g; Biotin, 0.05g; Folic acid 1g; Chlorine chloride 250g; Copper, 8g; Manganese, 64g; Iron 32g; Zn 40g; Iodine 0.6g; Flavomycin 100g; Spiramycin 5g;3-nitre 50g; DL -methionine, 50g; Selenium, 0.6g; Lysine 120g; BHT, 5g; E = Enzyme; P = Probiotic*

Growth of rabbits fed graded levels of yam peels meals for eight weeks was examined in grammes. The treatment contained 0%, 5%, 10%, 20% and 30% levels of yam peels named treatment 1,2,3,4 and 5 respectively. The initial weight of the rabbits in treatment 1,2,3,4 and 5 were 621.31, 619,00, 619.67, 621.00 and 416.00 respectively. At the end of eight weeks, the rabbits weigh 1343.833g, 1300.00g, 1550.500g, 1589.667g and 1846.333g resulting in a weight gain of 722.50g, 681g, 930.83g, 962.67g and 1430.33g across the treatments. The mean daily feed intake of the rabbits in treatments 1,2,3,4 and 5were 151.94g, 153.18g, 228.16g, 136.31g and 362.07grespectively. the feed conversion ratios were 4.76g, 4.45g, 4.08g, 7.06g and 3.95g respectively. Table 2.

Table 3: Growth Performance of Rabbits fed Graded levels of Yam Peels Treatments

Parameters	T_1 (0%)	T_2 (5%)	T_3 (10%)	T_4 (20%)	T_5 (30%)
Final weight (g)	1343.833	1300.00	1550.500	1583.667	1846.333
Initial weight (g)	621.33	619.00	619.67	621.00	416.00
Weight gain (g)	722.50	681	930.83	962.67	1430.33
Daily feed intake (g)	151.94	153.18	228.16	136.31	362.07
Feed conversion ration	4.76	4.45	4.08	7.06	3.95

The result indicates higher weight gain for treatments 3 and 4. This implies that the diets in treatments 3 and 4 with 10% and 20% level of inclusion of yam peels give the rabbits better growth performance, even though the feed intake in treatment 4 is lower. Also, despite the low feed intake in treatment4 the conversion ratio is highest. This is in tandem with existing theory of growth performance. The higher the feed conversion ratio, the higher the weight gains.

Table 4: Daily feed intake of Rabbits fed Graded levels of Yam Peels Treatments

Weeks	T_1 (0%)	T_2 (5%)	T_3 (10%)	T_4 (20%)	T_5 (30%)
1	105.71	83.57	104.38	102.38	83.76
2	87.05	115.05	124.76	103.86	87.52
3	94.32	107.38	109.71	100.00	109.0
4	174.57	155.14	758.71	125.86	146.90
5	162.00	165.76	163.09	135.81	129.69
6	193.52*	185.81	161.71	162.71	154.90
7	199.24	201.76*	204.14*	154.52	174.72
8	199.09	211.00	198.76	205.33	2010.00
Average	151.94	153.18	228.16	136.31	362.07

SEM= Standard error mean
NS=Not significant (p>0.05)
*=Significant (p>0.05)

Table 5: Weight gain of Rabbit fed graded levels of Yam Peels Treatments

Weeks	T1	T2	T3	T4	T5	SEM
1	621.33	619.00	619.67	621.00	416.00	24.90
2	864.33*	781.00*	880.00	717.17*	416.56	12.69
3	754.50	859.33	802.17	312.00	769.33	36.14
4	1052.17	128.48	986.67	807.17	933.33	94.49
5	1111.33	1040.33	124.74	923.97	996.33	240.96
6	1206.17	1128.50	1199.50	1395.66*	952.50	408.40
7	1239.17	1243.17	1338.67	1314.67	140.33	26.52
8	1343.83	1300.00	1550.50	1585.67	1846.33*	53.98

Table 6 Cost benefits of Rabbits fed graded levels of yam peels meals

Production parameters	Quantity (kg)	Unite price (₦)	Value (₦)	Percentage
Variable cost				
Rabbits acquisition cost	30	1500	45000	61.47
Feed	180		19205	26.23
Medication	-	-	3000	4.10
Labour	-	-	5000	6.83
Cage rent	-	-	1000	1.37
Total cost	-	-	73205	100.00
Income (revenue)	30	2500	75000	
Gross margin			1795	-
Gross ratio			1.024	-
Return on investment (%)			2.45	-

The profitability analysis of 30 rabbit's production using yam peel for eight weeks was carried out via gross margin technique. The results of the analysis (Table 6) show a total production cost of ₦73,205. The acquisition cost constituted the major (61.47%) proportion of the cost. This was followed by cost of feed, labour, medication and cage with 26.23%,6.83%, 4.10% and 1.37%respectively. The total revenue was ₦75,000 Gross margin of ₦1,795 was obtained with gross ratio and return on investment of 1.024% and 2.45% respectively. with gross rate of greater than 1 means that the rabbits production using yam peel meals is profitable. The rate of return on investment further justifies the worthiness of the enterprise. Olukosi et al, (2005) had explained that the worthiness of a farm enterprise is adjudged by the gross ratio. When a gross ratio of a farm is 1 the enterprise is at break-even less than 1 the enterprise is losing and greater than 1 the enterprise is making profit.

Rabbits game enterprise require minimum capital investments and the demand for the products is high. Rabbits provide white meat proteins source which is described especially among aged people. Rabbits are raised with forage and this study has proved that they can be raised using kitchen waste such as the yam peels. Therefore, rabbitary provides opportunity for kitchen waste recycling of yam peels.

Conclusion and Recommendations

The results of the study indicate that 30% yam peels meal could be incorporated into the diets of growing rabbits without adverse effects on the growth performance, carcass and body weight gain. Additional advantages are reduced cost and lower cost per kg weight gain observed on yam peels meals-based diets. There are incentives that could warrant the recommendation of yam peels meals as a dietary component for growing rabbits. Rabbits are raised with forage and this study has proved that they can be raised using kitchen waste such as the yam peels. Therefore, rabbitary provides opportunity for kitchen waste recycling of yam peels.

finally, yam peels meals had no deleterious effects on growing rabbits as evidenced by the growth performance of the rabbits fed on the experimental diets gain especially 30% inclusion.

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