



Biokemistri

An International Journal of the Nigerian Society for Experimental Biology

Research Article

Effect of Dietary Replacement of Maize with Yam and Irish potato peel meals on the Growth and Economic Performance of Growing Rabbits

Gambo Mohammed, Joseph U. Igwebuike, Bala S. Adamu, Lawan G. Ashiekh, Salisu S. Garba, Usman M. Kolo*

Department of Animal Science, University of Maiduguri, Maiduguri, Nigeria.

*Correspondence: Usman M. Kolo; uskolo220@gmail.com; +2348038329041

ABSTRACT: An eight-week feeding trial was conducted to investigate the effect of feeding yam and irish potato peel meals on the growth performance and economic analysis of cross-bred (Dutch x New Zealand white) growing rabbits aged between five to seven weeks. Thirty rabbits were randomly allocated to six dietary treatments with five rabbits per treatment. Diets 1, 2, 3, 4, 5 and 6 contained 100% maize, 50% maize and 50% yam peel meal, 50% maize and 50% irish potato peel meal, 50% yam peel meal and 50% irish potato peel meal, 100% yam peel meal and 100% irish potato peel meal, respectively. The response showed that the growth parameters were not significantly ($P>0.05$) different among the treatment groups except mean final body weight which was significantly ($P>0.05$) different. The mean final body weight of rabbits fed T3 diet (50% maize and 50% irish potato peel meal) was significantly ($P<0.05$) higher than those fed T2 (50% maize and 50% yam peel meal) and T6 (100% irish potato peel meal) diets, but were similar ($P>0.05$) to other diets. However, the lowest mean final body weight was obtained in rabbits fed T6 (100% irish potato peel meal) diet. The cost per kg feed decreased progressively as the levels of yam and irish potato peel meals increased in the diets. The cost per kg gain also declined from ₦ 249.59 in T1 (100% maize) to ₦ 181.95 in T4 (50% yam peel meal and 50% irish potato peel meal), which showed the best cost per kg weight gain. The study demonstrated that the yam and irish potato peel meals can replace maize up to 100% as energy source for growing rabbits without adverse effect on performance.

KEYWORDS: Growth Performance, Yam and Irish Potato peel meals, Economic Analysis.

Received: 30 March 2015; Revised 15 May 2015; Approved: 16 May 2015.

INTRODUCTION

The major hindrance to animal production in Nigeria is attributed to high cost of feedstuffs. 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 e.t.c (Akinmutimi, 2006). Maize grain has remained the major source of energy in rabbit feeds in Nigeria. Maize, which usually accounted for over 40% of the total diets of rabbits and is expensive (Adegbola and Okonkwo, 2002). This has brought about the renewed search for alternative feeds (Ijaiya and Awonusi, 2001).

Yam and Irish potato peels have been identified as alternative feedstuffs that can be used as sources of energy in livestock and poultry feeds (Adeyemo and Borrie, 2002). These potential feed resources described as non-conventional feeds (crop by-products) are fundamental to farming systems that produce both crops and livestock (Henning *et al.*, 2006). Crop by-products abound in Nigeria but they are not efficiently utilized by livestock farmers as potential feed resources (Ayuk *et al.*, 2011). This study was aimed at determining the effect of dietary replacement of maize with yam and irish potato peel meals in the diets of growing rabbits.

MATERIALS AND METHODS

Experimental Animals and Management

The study was conducted at the Livestock Teaching and Research Farm, University of Maiduguri, Maiduguri, Borno State, Nigeria. Thirty crossbred rabbits (Dutch x New Zealand white) between 5 and 7 weeks of age were used for the 8 – week feeding trial. The rabbits were individually weighed, equalized for weight and randomly assigned to the six (6) treatments in groups of five (5). Each rabbit was caged individually. The rabbits were provided with the experimental diets and clean drinking water *ad libitum*. Data collection commenced after an initial adjustment period of seven days.

Experimental Diets

The experimental diets are shown in Table 1. Maize, yam peel meal (YPM), irish potato peel meal (IPPM), wheat offal, groundnut haulm, groundnut cake, fish meal, limestone, common salt and premix were used in compounding the experimental diets. The diets contained various levels of maize and the peels as shown in Table 1. Diets 1, 2, 3, 4, 5 and 6 contained 100% maize, 50% maize and 50% yam peel meal, 50% maize and 50% irish potato peel meal, 50% yam peel meal and 50% irish potato peel meal, 100% yam peel meal and 100% irish potato peel meal, respectively.

Table 1: Ingredient Composition of the Experimental Diets.

| Ingredients (%) | T1 | T2 | T3 | T4 | T5 | T6 |
|------------------------|---------------|------------------------|-------------------------|-----------------------|---------------|---------------|
| | 100% Maize | 50% Maize + 50% YPM | 50% Maize + 50% IPPM | 50% YPM + 50% IPPM | 100% YPM | 100% IPPM |
| Maize | 34.00 | 17.00 | 17.00 | 0.00 | 0.00 | 0.00 |
| Wheat Offal | 17.00 | 17.00 | 17.00 | 17.00 | 17.00 | 17.00 |
| Yam Peel Meal | 0.00 | 17.00 | 0.00 | 17.00 | 34.00 | 0.00 |
| Irish Potato Peel Meal | 0.00 | 0.00 | 17.00 | 17.00 | 0.00 | 34.00 |
| Groundnut Cake | 27.00 | 27.00 | 27.00 | 27.00 | 27.00 | 27.00 |
| Fish Meal | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 |
| Groundnut Haulms | 16.50 | 16.50 | 16.50 | 16.50 | 16.50 | 16.50 |
| Limestone | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 |
| Salt (NaCl) | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| Premix* | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

* Premix (grow fast) Manufactured by Animal Care Service Consult (Nig) Ltd. Lagos, Supplying the following per kg of premix: Vitamin A, 5000.00 IU; Vitamin D₃ 800,000IU; Vitamin E, 12,000mg; Vitamin K, 1,500mg; Vitamin B₁, 1,000mg; Vitamin B₂, 2,000mg; Vitamin B₆, 1,500mg; Niacin, 12,000mg; Pantothenic acid, 20,000mg; Biotin, 10,000mg; Vitamin B₁₂, 300.00mg; Folic acid, 150,000mg; Choline, 60,000mg; Manganese, 10,000mg; Iron, 15,000 mg; Zinc 800.00mg; Copper 400.00mg; Iodine 80.00mg; Cobalt 40mg; Selenium 8,00 mg. YPM = Yam peel meal; IPPM = Irish potato peel meal

Table 2: Proximate Composition of the Experimental Diets.

| Nutrient (%) | T1 | T2 | T3 | T4 | T5 | T6 |
|--------------------|---------------|------------------------|-------------------------|-----------------------|-------------|--------------|
| | 100% Maize | 50% Maize + 50% YPM | 50% Maize + 50% IPPM | 50% YPM + 50% IPPM | 100% YPM | 100% IPPM |
| Dry Matter (DM) | 95.90 | 91.10 | 96.70 | 96.00 | 96.20 | 96.00 |
| Crude Protein (CP) | 21.33 | 20.38 | 21.28 | 20.33 | 19.42 | 21.24 |
| Crude Fibre (CF) | 8.75 | 9.64 | 10.54 | 11.42 | 10.52 | 12.32 |
| Ether Extract (EE) | 1.10 | 1.70 | 1.60 | 1.50 | 2.40 | 1.50 |
| Ash | 2.00 | 3.50 | 2.00 | 4.20 | 1.50 | 4.30 |
| NFE | 62.72 | 55.88 | 61.28 | 58.55 | 62.16 | 56.64 |
| ME (kcal/Kc) | 3096.77 | 2875.50 | 3092.40 | 2952.24 | 3119.62 | 2918.10 |

NFE = Nitrogen-Free Extract; ME = Metabolizable energy calculated according to the formula of Pausenga (1985); as: ME = 37x%CP+81x%EE+35.5x% NFE; YPM = Yam peel meal; IPPM = Irish potato peel meal.

Data collection

The daily feed intake was obtained by subtracting the left over from total amount of feed supplied. Each rabbit was weighed at the inception of the experiment and weekly thereafter to obtain the weekly and daily body weight gain throughout the experimental period. The feed conversion ratio was calculated as the dry matter feed intake per unit weight gain. The proximate composition of the diets and test material (yam peel meal and irish potato peel meal) were determined according to AOAC (2000).

Table 3: Growth Performance of Rabbits Fed Graded Levels of Yam and Irish Potato Peel Meals.

| Nutrient (%) | T1 | T2 | T3 | T4 | T5 | T6 | SEM |
|------------------------------|------------------------|------------------------|-------------------------|-----------------------|------------------------|----------------------|---------------------|
| | 100% Maize | 50% Maize + 50% YPM | 50% Maize + 50% IPPM | 50% YPM + 50% IPPM | 100% YPM | 100% IPPM | |
| Mean Initial Body Weight (g) | 450.00 | 445.00 | 438.00 | 446.00 | 446.11 | 446.10 | 35.04 ^{NS} |
| Mean Final Body Weight (g) | 1176.40 ^{abc} | 1112.80 ^{bc} | 1262.80 ^a | 1195.00 ^{ab} | 1146.80 ^{abc} | 1058.00 ^c | 40.55 [*] |
| Mean Feed Intake (g) | 58.28 | 55.85 | 55.48 | 62.41 | 57.38 | 58.30 | 3.10 ^{NS} |
| Mean Daily Weight Gain (g) | 12.97 | 12.56 | 13.00 | 13.31 | 12.29 | 10.93 | 1.69 ^{NS} |
| Feed Conversion ratio (g) | 5.38 | 5.57 | 5.98 | 5.40 | 5.03 | 5.52 | 0.83 ^{NS} |
| Mortality | 0 | 0 | 0 | 0 | 0 | 0 | - |

SEM = Standard error of means, NS = Not significant ($P>0.05$); ^{*}=Significant ($P<0.05$); a,b,c = Means in the same row bearing different superscripts differ significantly ($P<0.05$); YPM = Yam peel meal; IPPM =Irish potato peel meal.

Economic analysis

The economic implication of including yam peel meal and irish potato peel meal in the diets of growing rabbits was assessed by calculating the: (i) Total feed intake per rabbit; (ii) Total weight gain; (iii) Cost per kilogramme of each diet; and (iv) Cost per kilogramme of weight gain by the rabbit.

Statistical Analysis

Data collected were subjected to analysis of variance and where significant differences were observed, means were compared by Duncan's multiple range test (Duncan, 1955) as outlined by Steel and Torrie (1980).

RESULTS AND DISCUSSION

Proximate Composition of the Experimental Diets

The proximate composition of the experimental diets is presented in Table 2. The crude protein (CP) is lower in yam peel meal (4.38%) than in maize (8.9%), while slightly higher in irish potato peel meal (9.7%). However, the CP obtained in this study is lower than the value (11.10%) reported by Akinmutimi and Anakebe (2008) for yam peel meal. The difference in CP may be attributed to the different processing method of the yam peel meal and probably the variety of yam.

The crude protein (CP) values (19.42 – 21.24%) obtained in all the experimental diets were numerically similar and satisfied the recommended level (18%) for growing rabbits in the tropical environment (Fielding, 1991). The crude fibre (CF) levels ranges from 8.75 – 12.24% which increased progressively as the levels of yam and irish potato peel meals increased in the diets. This is in line with the observation of Akinmutimi and Anakebe (2008) who fed yam and sweet potato peel meals in place of maize in diets of growing rabbits.

The ether extract and nitrogen free-extract (NFE) were numerically similar in all the diets. The total ash content were higher in diets T4 (50% YPM and 50% IPPM) and T6 (100% IPPM) while the lowest value was recorded in diet T5 (100% YPM). The metabolizable energy (ME) which ranges from 2875.50 to 3119.62 kcal/kg were also numerically similar but higher than the values (2500 – 2600 kcal/kg) recommended by Omole *et al.* (2007) for growing rabbits in Nigeria.

Growth Performance of Rabbits Fed Graded Levels of Yam and Irish Potato Peel meals

The growth performance of the rabbits fed graded levels of yam and irish potato peel meals is shown in Table 3. All the parameters were not significantly ($P>0.05$) different except mean final body weight which is significantly ($P<0.05$) different. This is an indication that yam and irish potato peel meals can replace maize in the diets of growing rabbits without adverse effect on growth performance. The mean final body weight of rabbits fed T3 diet (50% maize and 50% irish potato peel meal) was significantly ($P<0.05$) higher than those fed T2 (50% maize and 50% YPM) and T6 (100% irish potato peel meal) diets, but was similar ($P>0.05$) to other diets. However, the lowest mean final body weight was obtained in rabbits fed T6 diet. This result agreed with the report of Ayoola and Akinbani (2011) who replaced maize with sun-dried yam peel meal in the diets of meat-type rabbits.

The mean daily feed intake (55.48 – 62.41 g) were lower than the values (76.39 – 86.21 g) reported by Osakwe and Nwose (2008) who fed cassava peel in the diet of weaner rabbit in place for maize. The difference observed may be due to the levels of crude fibre (8.15 – 12.24%) in the diets which were higher than the values (7.30 – 8.49%) reported by Osakwe and Nwose (2008). Under certain conditions, such as high ambient temperature and high fibre in the diets, feed intake may be depressed (Preston, 1987).

Table 4: Economic Analysis of Rabbits Fed Graded Levels of Yam and Irish Potato Peel Meals as Replacement for Maize.

| Nutrient (%) | T1 | T2 | T3 | T4 | T5 | T6 |
|--------------------------------|---------------|------------------------|-------------------------|-----------------------|----------|--------------|
| | 100% Maize | 50% Maize + 50% YPM | 50% Maize + 50% IPPM | 50% YPM + 50% IPPM | 100% YPM | 100% IPPM |
| Initial Weight Gain (g/rabbit) | 450.00 | 445.00 | 438.00 | 446.00 | 446.11 | 446.10 |
| Final Live Weight (g/rabbit) | 1176.40 | 1112.80 | 1262.80 | 1195.00 | 1146.80 | 1058.00 |
| Total Weight Gain (g/rabbit) | 726.38 | 703.36 | 727.78 | 745.36 | 688.02 | 611.97 |
| Total Weight Gain (Kg/rabbit) | 0.73 | 0.70 | 0.73 | 0.75 | 0.69 | 0.61 |
| Total Feed Intake (g/rabbit) | 3263.68 | 3127.32 | 3107.07 | 3495.02 | 3213.34 | 3264.74 |
| Total Feed Intake (Kg/rabbit) | 3.26 | 3.13 | 3.11 | 3.50 | 3.21 | 3.26 |
| Cost/Kg Feed (Naira)* | 55.89 | 48.29 | 46.59 | 38.99 | 40.69 | 37.29 |
| Total Feed Cost (Naira)* | 182.20 | 151.15 | 144.89 | 136.47 | 130.61 | 121.57 |
| Cost/Kg Gain (Naira)* | 249.59 | 215.93 | 198.49 | 181.95 | 189.30 | 199.30 |

*Calculated based on the market price of the ingredients (₦/kg) at the time of the experiment (maize = 64.71; yam peel meal = 20.00; irish potato peel meal = 10.00; wheat offal = 46.00; groundnut cake = 44.00; fish meal = 74.29; groundnut haulm = 59.38; limestone = 55.60; premix = 400; salt = 200); ₦ 160 = \$1 at the time of the experiment (2013); YPM = Yam peel meal; IPPM =Irish potato peel meal.

The mean daily weight gain obtained is similar to the result recorded by Akinmutimi and Anakebe (2008) who fed yam and sweet potato peel meals as a replacement for maize and observed no significant ($P > 0.05$) difference in the mean daily weight gain. The feed conversion ratio (5.03 – 5.98) were similar to the values (4.39 – 6.64) reported by Osakwe and Nwose (2008) for rabbits fed graded levels of cassava peel meal, but better than the values (6.56 – 7.99) reported by Akinmutimi and Anakebe (2008) who fed rabbits with yam and sweet potato peel meal in place of maize.

Economic Analysis

The results of the economic analysis presented in Table 4 shows that the cost per kg feed decreased progressively as the levels of yam and irish potato peel meals increased in the diets. This is because yam and irish potato peel meals are cheaper than maize. The cost per kg gain also declined from ₦ 249.59 in T1 (100% maize) to ₦ 181.95 in T4 (50% yam peel meal and 50% irish potato peel meal), which also showed the best cost per kg weight gain. The more the quantity of yam and irish potato peel meals added in the diets, the less expensive the diet becomes. Thus, incorporating yam and irish potato peel meals into diets of growing rabbits lowered the feed cost and cost per kg gain. The result agrees with the findings of Ayoola and Akinbani (2011) who replaced maize with sun-dried yam peel meal in the diet of meat-type rabbits and observed reduction in both feed cost and cost per kg gain.

Conclusion

The yam and irish potato peel meals can be used successfully to replace maize, which is the conventional energy source, in rabbit diets without adverse effect on growth performance. Additional advantage are decreased feed cost and feed cost per kg gain as the levels of yam and irish potato peel meals increased in the diets. Therefore, rabbits farmers are encouraged to use yam and irish potato peel meals as energy sources in the diets of growing rabbits.

REFERENCES

- Adegbola, T. A. and Okonkwo, J. C. (2002). Nutrient intake, digestibility and growth rate of rabbits fed varying levels of cassava peel meal. *Nigerian Journal of Animal Production*. 29 (29): 21-26.
- Adeyemo, A. I. and Borrie, O. I. (2002). Response of giant snail (*Archachatina marginata*) to graded levels of yam peel meal based diets. *Proceedings of the 27th Annual Conference of Nigerian Society for Animal Production (NSAP)*. Federal University of Technology Akure, Nigeria .Pp. 335-336
- Akinmutimi, A. H. (2001). The effect of potash-cooked lima bean (*Phaseolus lunatus*) on broiler starter diets. *Nigerian Agricultural Journal*. 32: 109-118

- Akinmutimi, A. H. (2006). Nutritive value of raw and processed Jack fruit seed (*Artocarpus heterophyllus*): Chemical analysis. *Agricultural Journal*. 1: 266-271
- Akinmutimi, A. H. and Anakebe, O. C. (2008). Performance of weaner rabbits fed graded levels of yam and sweet potato peel meal in place of maize base diets. *Pakistan Journal of Nutrition*. 7(5): 700-704
- AOAC (2000). *Official Methods of Analysis of Official Analytical Chemists*. 17th Edition. Ed. Horwitz, W., Washington, D.C., Association of Official Analytical Chemists. Pp. 55-101.
- Ayoola, M. A. and Akinbani, A. S. (2011). Effects of replacing maize with sun-dried yam peel meal on growth performance, carcass characteristics and economics of production of meat-type rabbits *Animal Research International*. 3(4): 70-73.
- Ayuk, A. A., Kalio, G. A., Agwunobi, L. N. and Okon, B. I. (2011). Agro-by product feed stuffs and livestock management systems for rural livelihoods in Cross River State. *Journal of Agricultural Science*, 3(2): 191-197.
- Duncan, D. B. (1955). Multiple range and multiple F. tests. *Biometrics* 11: 1 – 42.
- Fielding, D. (1991). *Rabbits*. McMillan Press Ltd London and Basingstoke. P. 106.
- Henning, S., Pierre, G., Tom, W., Vincent, C., Mauricio, R. and de-Hann, C. (2006). Livestock long shadow, Environmental Issues Options. FAO, Rome, Italy. P. 390
- Ijaiya, A. T. and Awonusi, E. A. (2001). Effect of replacing maize with yam peel meal on the growth performance of weaner rabbits. *Proceedings of 7th Annual Conference of the Animal Science of Nigeria (ASAN)* Abeokuta, Nigeria. Pp. 91-93.
- Omole, A. J., Ajasin, F. O., Oluokun, J. A. and Tiamiyu, A. K. (2007). *Rabbit farming without tears*. Green choice Agric publication, Ibadan. Pp 2-40.
- Osakwe, I. I. and Nwose, R. N. (2008). Feed intake and nutrient digestibility of weaner rabbits fed cassava peel as replacement for maize. *Animal Research International*. 5(1): 770-773.
- Pauzenga, U. (1985). Feeding Parent stock. *Zootecnia International* Pp. 22-25
- Preston, T. R. (1987). *Pig and poultry in the tropics*. Wageningen, Netherland, technical center for Agriculture co-operation (CTA) P. 25.
- Steel, R. G. D. and Torrie, J. A. (1980). *Principles and Procedures of Statistics. A Biometrical Approach*, 2nd Ed. Mc Graw-Hill Book Co. Inc. NewYork, p. 633.