The replacement value of unripe plantain peels on the growth performance, carcass characteristics and cost implications of rabbit production in the tropical region

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Abstract: A total of thirty two weaned rabbits of 5 to 6 weeks of age were randomly assigned to four dietary treatments at 0, 25, 50 or 75% in a completely randomized design experiment to evaluate the effect of unripe plantain peels on the growth performance, carcass characteristics, muscle development and cost benefit of weaned rabbits. A feeding trial lasting for 63 days was carried out, at the end of which twenty rabbits were slaughtered to determine the carcass characteristics, muscle development and organ weights. Results on performance showed that the dietary treatments influenced ($P<0.05$) the average feed consumed, average body weight gain and feed conversion ratio of the rabbits with the highest average body weight gain (12.8±0.15) recorded for rabbits placed on 50%-based unripe plantain peel diet. On the carcass traits, the limbs and the tail weights were significantly lower (29.88±0.47) and 3.94±0.03, respectively) at 75%-based unripe plantain peel diet. Other parameters showed no significant difference ($P>0.05$) with the reference diet. Dietary treatments had no positive influence on the lung, kidney and heart weights at 75%-based plantain peel inclusion level as the lowest values were recorded at this level. Replacing maize at 50% with unripe plantain peel resulted in reduced cost of feed as well as cost/kg weight gain of rabbit production. Consequently, net return was raised by 26.99%, 43.77% and 51.68% at 25, 50, and 75%, respectively with unripe plantain peel substitution. The increase in net return was most encouraging at 50%-based plantain peel substitution, being the diet with the least cost per kilogram weight gain that did not compromise the performance of the rabbits.
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Key words*:* unripe plantain peels, growth performance, carcass characteristics, cost benefit, rabbit production.

Introduction

Rabbit production is becoming increasingly important in the tropics particularly Nigeria. The reasons are that they are easy to manage, require a small space, able to thrive on forage and has short generation interval. The domestic rabbits compete favourably well with other livestock in its efficient conversion of feed into good quality meat for human consumption. One notable characteristic of rabbit meat is its tenderness. In addition to this, the meat is of a fine quality, high in protein (20.8%) and low in fat content (10.2%) (Eshiett *et al.*, 1979) .The low content of fat especially cholesterol make it suitable for hypertensive patients. Although rabbit is known to furnish adequate protein in human diet, the high cost of commercial pellets (Amata & Bratt, 2008) which may constitute about 70% of the total cost of production has seriously affected the rabbit industry in Nigeria. This present cost of feed ingredients has made it necessary to look inwards for alternative feed resources which are readily available and relatively cheaper than the conventional sources like maize, sorghum, millet, soybeans, groundnut cake, fish meal and other supplements, and at the same time not important as an item of human food. Plantain peels, a waste from plantain is observed to have some nutritional values as it contains about 12% crude protein, 16% crude fibre and 1300kcal/kg energy on dry matter basis (Aduku, 1993, Ajasin *et al.*, 2004). This waste is known to constitute a menace to the society thereby adding to the worse problem of environmental pollution particularly in places where ruminants (sheep and goat) are not allowed to roam about. Omole *et al.*, (2008) reported no significant difference in the weight gain of weaned rabbit fed 15% plantain peels in place of maize. Further study by Tewe (1983) revealed that fresh plantain peels are good sources of energy for broilers. Although information is available on the utilization of plantain peels by ruminants, information is still

not sufficient on the utilization and economics of production of rabbit using plantain peels as replacement for maize. This study was carried out to determine the nutritional potential of dried unripe plantain peels and the cost implications on of raising rabbits with unripe plantain peels in the tropical region.

Materials and methods

Location

This study was carried out between Jan, 21 and March, 23, 2010 at the rabbitary unit of the Teaching and Research farm, Adeyemi College of Education, Ondo, Nigeria.

Test ingredient and experimental diets

Fresh unripe plantain peels were collected from a plantain feed mill in Akure, Ondo State. They were chopped and immediately dried under shade for several days. They were thereafter milled to obtain plantain peel meal (PPM) and were incorporated to four dietary treatments in such a way that plantain peels replaced maize at 0, 25, 50 and 75%. Other feed ingredients were purchased at Adedom Feed mill in Akure, Ondo State, Nigeria. The diets (Table 1) were formulated to contain approximately 20% crude protein and 2300 kcal kg^{-1} metabolizable energy (ME).

Dry samples of plantain peel meal and the experimental diets were analyzed for their proximate composition (AOAC,1990).

Table 1. Composition of experiment diets (g/100g) for growing rabbits

Ingredients (kg)	Levels of substitution (%) 0	25	50	75
Maize	57.96	43.47	28.98	14.49
Plantain peels	-	15.94	31.88	47.82
GNC	28.00	27.50	27.00	26.50
Rice bran	12.44	11.49	10.54	9.59
Premix	0.08	0.08	0.08	0.08
Salt	0.02	0.02	0.02	0.02
Bone meal	1.50	1.50	1.50	1.50
Calculated composition				
Energy (kcal ME/kg	2313.50	2325.00	2333.00	2341.50
Crude protein (%)	20.02	19.65	19.55	19.50
Crude fibre (%)	5.59	6.58	7.69	7.78

Pre-experimental period

The cages were constructed with wooden materials to house 40 growing rabbits of about 5 to 6 weeks of age with an average weight of 405.10g. Each compartment measures 70 x 60 x 50cm so as to be able to house one rabbit conveniently. The rabbits were fed 14 days adaptation period in their individual cages on commercial feed to enhance uniform growth and to acclimatize to the facilities and conditions in the cage. The experimental design was completely randomized design (CRD).

Management of the animals

At the end of the pre-experimental period, thirty two rabbits of mixed sexes were weighed individually and randomly assigned to their respective diets with eight rabbits per treatment and one rabbit per replicate. The hutches were raised 75cm above the ground and the stands immersed in insecticidal solution.

All necessary housing conditions to permit proper ventilation and security against insect, and reptiles were observed. The rabbits were fed their respective experimental diets *ad-libitum* for 9 weeks with clean water supplied.

Data collection

At the end of the ninth week, five rabbits were chosen at random from each treatment group, starved overnight, stunned, sacrificed by cervical dislocation and dissected in accordance with guidelines of the World Rabbit Science Association (WRSA). The carcasses were then removed and weighed. Data were also collected on feed intake, body weight gain, feed conversion and digestibility.

Data analysis

Data collected were analyzed by one-way analysis of variance procedure using SPSS (Version 10.0) computer software. Where significant differences exist, the means were

separated using Duncan's Multiple Range Test Procedure (Duncan, 1955).

Results and discussion

The proximate composition of test ingredient and the experimental diets are shown in Table 2. The values obtained fell within the range of nutrients earlier reported for plantain peels (Aduke, 1993, Ajasin *et al* (2008). The energy and proximate values of the diets also fell within the recommended range of nutrients required by rabbits for optimum growth performance (Ajasin *et al*., 2004, Omole *et al.*, 2008). Data on performance characteristics are in Table 3. The means feed intake, body weight gain and feed conversion rate were significantly different (P<0.05) from the control diet. Although feed intake decreased marginally with increased level of plantain peels (Ajasin etal., 2004, Babajide,1998, Fetuga etal., 1974), but this decrease did not affect the weight gain, rather weight gain increased up to 50% level of plantain peel inclusion. The differences in feed intake could be attributed to taste and fibre content of the feed [5(Omole etal 2008)]. The highest body weight gain (12.81±0.15gkg^{-1}) was recorded on diet 3 while the lowest (11.38±0.12gkg^{-1}) was obtained on diet 1. A feed conversion rate (7.21±0.15) was recorded on diet 3 as against a value of (9.15±0.14) obtained on diet 1. Birds fed diet 3 recorded the highest (717.34±1.55g kg^{-1}) mean body weight gain while birds on diet 1 (control diet) recorded the lowest (637.33±1.82g kg^{-1}) mean body weight gain. The implication therefore is that plantain peel inclusion at 50% level promotes better growth performance of rabbit.

Table 2. Proximate composition of the test ingredient and experimental diets
Constituents (g100g^{-1} dry sample)

	DM	CP	CF	EE	ASH	NFE
Plantain peels	92.32	10.91	9.05	5.6	11.27	63.16
Experimental diets (%)						
0	89.56	19.87	5.68	4.42	8.19	61.84
25	87.16	19.81	6.25	4.89	9.48	59.57
50	86.01	19.79	6.47	5.01	9.13	59.60
75	90.13	19.75	6.59	5.81	9.65	58.20

Table 3. Performance of rabbits fed graded levels of PPM as replacement for maize

Performace parameters	Levels of substitution (%) 0	25	50	75
Initial body weight (g)	425.00±3.21	391.67±3.07	433.33±3.11	406.67±3.19
Final body weight (g)	1062.33±5.02	1105.67±4.31	1150.67±2.75	1045.67±2.53
Live shrunk weight	1005.93±4.35	1050.92±3.56	1148.48±3.15	993.34±4.21
Average feed consumed/ rabbit/day	104.12±0.94^{a}	98.14±1.16^{a}	92.37±0.55^{b}	87.13±1.03^{b}
Average weight gain/ rabbit/day (g)	11.38±0.12^{a}	12.75±0.17^{b}	12.81±0.15^{b}	11.41±0.16^{a}
Feed conversion ratio	9.15±0.14^{a}	7.69±0.17^{b}	7.21±0.15^{b}	7.64±0.12^{b}
Feed digestibility	71.80±1.09	74.63±1.28	73.93±2.40	73.75±1.64
Mortality	0	0	0	0

Means in the same row with different superscripts are significantly different (P<0.05).

Carcass and organ weights

Results on rabbits carcass and organ weights are shown in Tables 4 and 5. Results showed no significant difference (P>0.05) in the head, neck, skin (pelt), shoulder, loin, rib and thigh weights of rabbits on the different dietary treatments. Although head weight increased linearly to increased level of plantain peel but the effect of the dietary treatment was not statistically shown. The non-significant difference recorded in this study for these carcass characteristics suggest close similarities between the nutritive value of maize and plantain peel (Ajasin *et al*., 2004). The results on the limbs and tail weights of rabbits placed on diet 4 was significantly lower (P<0.05) than those on diets

1, 2 and 3 that showed no significant difference (P>0.05).

Results on the organ weights as contained in Table 5 showed no significant difference (P>0.05) in the intestine and liver weights of the dietary treatments while significant differences (P<0.05) exist between the lung, kidney and heart weights of rabbits placed on diet 4 compared with other test diets. Diet 4 (75%) recorded the lowest values for lung, kidney and heart weights as these organ weights decreased significantly above 50% plantain inclusion level. This is line with the reports by Agbede & Aletor, (2003), Ajaja *et al*., (2002), Agbede *et al*., (2000) and Awoniyi *et al.,* (2000) that dietary treatments exert some influences on certain carcass and organ developments.

Table 4. Carcass traits (gkg^{-1} body weight) of rabbits fed diets with graded levels of PPM as replacement for maize.

Parameters	Levels of substitution (%)			
	0	25	50	75
Dressed carcass weight	403.88±3.32	396.74±3.36	423.02±3.01	400.50±2.97
Eviscerated weight	334.97±2.50	372.21±3.51	377.73±2.61	321.91±1.90
Head	123.23±1.42	118.26±1.32	129.25±1.08	138.65±0.69
Neck	19.77±0.18	24.11±0.15	16.79±0.14	14.75±0.10
Limbs	3 5.87±0.51^{a}	38.51±0.32^{a}	37.12±0.12^{a}	29.88±0.41^{b}
Tail	6.29±0.07^{a}	5.68±0.06^{a}	5.87±0.04^{a}	3.94±0.03^{b}
Pelt (skin)	65.33±0.93	72.31±0.26	61.93±0.30	64.35±0.43
Shoulder	108.44±1.93	112.04±1.02	94.42±0.94	98.41±0.75
Loin	76.46±0.71	70.62±0.57	72.39±0.31	76.41±0.62
Rib	54.97±0.53	56.94±0.43	48.58±0.51	48.98±0.37
Thigh	181.02±1.71	182.12±0.73	170.36±0.59	174.82±0.28

Means in the same row with different superscripts are significantly different (P<0.05)

Table 5. Organs weight (gkg^{-1} body weight) of rabbits fed diets with graded levels of PPM as replacement for maize

Parameters	Levels of substitution (%)			
	0	25	50	75
Intestine + contents	291.11±1.35	325.43±1.07	318.07±0.75	290.37±1.12
Liver	26.81±0.10	27.28±0.40	28.60±0.31	26.37±0.15
Lung	8.90±0.04^{a}	9.43±0.02^{a}	9.77±0.08^{a}	6.97±0.07^{b}
Kidney	11.47±0.02^{a}	11.67±0.03^{a}	11.70±0.02^{a}	10.21±0.04^{b}
Heart	4.17±0.03^{a}	4.09±0.02^{a}	4.07±0.02^{a}	3.57±0.03^{b}

Means in the same row with different superscripts are significantly different (P<0.05)

Table 6 shows the results of the cost implications of feeding rabbits with graded levels of unripe plantain peels. The total cost of feed per kilogram was lowest (₦42.45) at 75% plantain peel inclusion. The cost of feed decreased from 14.10% in 25% to 42.02% in rabbit fed 75% plantain peel substituted for maize. The cost of feed ₦/kg weight gain also decreased with increased plantain peels inclusion level. Cost differential per kilogram and relative cost benefit per kilogram gain show improved savings and profitability with the use of plantain peels as compared with maize in rabbits diets. The interpretation therefore is that since the replacement of maize with plantain peels did not hamper growth in rabbits, its utilization in feed formulation could be encouraged as this is expected to bring down the price of meat to a level affordable by a majority of meat consumers. It is therefore expected that such replacement would help make animal protein available and affordable to an average Nigerian and at the same time reduce competition between man and animals` for maize.

Conclusion

The use of 50% based plantain peel in place of maize in rabbit production was found to be most suitable, as this level supported good growth of rabbit with the least cost production

that did not compromise the performance of the rabbits. The use of plantain peel meal at 318.8gkg^{-1} substituted for maize can be recommended to farmers in this part of the world.

Table 6. Cost implications of rabbit fed diets with graded levels PPM as replacement for maize.

Diets	% maize replaced with PPM	Total no of rabbits	Av. wt gain (kg)	Av. feed consumed (kg)	cost of feed/₦ (kg)	cost of feed/Kg wt. gain	% cost reduction	cost differ-entail	relative benefit cost (%)
1	0	8	0.72	6.6	73.21	671.09	-	-	-
2	25	8	0.80	6.2	62.96	489.94	14.00	181.15	26.99
3	50	8	0.81	5.8	52.70	377.35	28.02	293.74	43.77
4	75	8	0.72	5.5	42.45	324.27	42.02	346.82	51.68

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