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Growth indices, haematological parameters, carcass attributes and economics of production of rabbits fed graded levels of kolanut testa

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Abstract

The cost of feed is the main cause of high cost of production of rabbits. Kolanut testa, a protective covering of the kolanut seed (Cola nitida) is readily available as by-product in areas where kolanut is produced. Thus, the objective of this study was to assess the growth performance, carcass attributes, haematological parameters and economics of production of rabbits fed diets with varying inclusions levels of kolanut testa (KOT) as replacement for maize. Thirty mixed breed rabbits of mixed sexes were used for this experiment. The rabbits were randomly allotted into 5 treatment groups. Five experimental diets were formulated such that KOT replaced maize at 0, 10, 20, 30 and 40%. Records of feed intake and weight gain were properly taken and blood samples were collected and analysed for their haematological parameters at the end of the experiment. Cost analysis using dedicated formulae was done to determine economics of production. The experiment lasted for eight weeks. Data were analyzed using Analysis of Variance. No significant (P>0.05) difference was recorded in all the parameters measured to determine growth performance. The same applies to parameters measured for carcass attributes except for weight of limbs. Significant (P<0.05) difference was however recorded among mean values of PCV (28.67-36.33%), RBC (3.14-4.12x10^6/mm^3), WBC (3.10-5.87x10^3/mm^3) and Mon (1.40-1.67%) of the experimental animals. Cost of feed decreased with increase in KOT inclusion (₦139.8-₦112.54). Cost of feed (₦/kg) weight gain (₦1023.61-₦583.04); cost of weight gain (₦573.22-₦483.92); and total cost (₦2143.61-₦1523.92) all followed similar pattern. Cost differential (205.93–440.04) and relative cost benefit (20.11–43.04%) increased with increase in the level of replacement of KOT. Conclusively, growth performance was not negatively affected and total weight gain was numerically highest at 40% (916.67g) with no deleterious effect on the health of the rabbits. Also, the highest relative cost benefit was recorded at 40% (28.54%). These prove that KOT is a viable substitute for maize in rabbit diet and it is more economical at 40% replacement level.

Keywords: Blood indices, Feeding cost, Rabbit meat, Rabbit production, Kolanut by-product, Unconventional feed ingredient

Introduction

The need to improve on rabbit production for the supply of animal protein for man, especially for people of developing countries where the consumption of protein is generally low, cannot be overemphasized. Protein consumption in Nigeria, for instance, is less than 10g per day per caput with only 3.2g of this from animal source (Abu *et al*., 2008). Rabbit production can help in solving this problem. Rabbits, besides their high prolificacy and ease of raising, are source of high quality meat which is high in protein and low in fat. One limiting factor to the production of rabbits, however, is the cost of production.

The cost of feed is the main cause of high cost of production of rabbits. Feed cost amounts to about 60% of the cost of production (Ikani *et al.,* 2001). Conventional feed ingredients which are also directly consumed by man e.g. maize

and soya beans are the main reasons for high cost of feed. The demand for these ingredients and the resultant competition for consumption between man and livestock have led to the increase in the prices of these ingredients.

The numerous uses of maize for human consumption, as animal feed and as input in other industrial activities has made its demand overly high with a consequential rise in price and hence, resulting into high production cost of livestock (Balogun *et al.,* 2016*;* Aderemi and Wuraola, 2010). This has led to the quest for unconventional ingredients with less or no cost to replace the expensive conventional ones. The aim is toreduce the cost of feed production and subsequently, the total cost of production of livestock (Ojabo *et al.,* 2012). Kolanut testa is the protective covering of the kolanut seed (*Cola nitida)* inside the pod. It is readily available in areas where kolanut is produced and processed and it is in fact a by-product of kolanut production.

The objective of this study was to assess the growth performance, carcass attributes, haematological parameters and economics of production of rabbits fed diets with varying inclusions of kolanut testa meal as replacement for maize.

Materials and methods

Experimental site

The experiment was carried out at the Rabbitry Unit of the Teaching and Research Farm, Adeyemi College of Education, Ondo state, Nigeria. The experimental site is located between the Latitude7 ° 1 fl N and Longitude 4 ° 83 fl E. Ecologically, the area lies in the rain forest zone of Nigeria.

Experimental animals and management

Thirty mixed breed rabbits (New Zealand White x Chinchilla) of mixed sexes were used for this experiment. The rabbits were of an average weight of 0.7kg and they were randomly allotted into five treatment groups which were replicated 6 times each in a completely randomized design. Each rabbit was housed in a separate hutch in the same cage. The hutches were **equipped with feeders and drinkers.**

The experiment lasted for eight weeks. The animals were firstly allowed to acclimatize for a period of two weeks before the start of the experiment. The initial weight of each rabbit was taken before introducing them to the experimental diets. The animals were fed and given fresh water twice daily (morning and evening). The cage and the floor of the pen were cleaned daily for the control of disease causing micro-organisms.

Experimental diets

Kolanut testa was collected from areas of production and sale of kolanut in Ondo town and environ at no cost. The test ingredient was air-dried for two weeks and milled before incorporating into the diets of the animals. Five experimental diets were formulated such that (KOT) replaced maize at 0, 10, 20, 30 and 40%.

Parameters measured

Records of daily feed intake and weekly weight gain were taken throughout the period of the experiment. After the 8th week, the animals were starved overnight, weighed, slaughtered and cut into parts for measurement. They were stunned before slaughtering. Blood samples were collected into labelled EDTA bottles for haematological analysis during slaughtering.

Statistical analysis

Data collected were analysed using Analysis of Variance (ANOVA) at 5% probability level and mean were compared using Duncan's Multiple Range Test (DMRT) of SPSS version 23.

Cost analysis

The following formulae were used to determine the economics of production of the rabbits:

Table 1: Gross composition (%) of the experimental rabbit diets

Ingredients	Percentage inclusion of kolanut testa				
	0	10	20	30	40
Maize	57.30	51.56	45.83	40.09	34.36
Kolanut testa	-	5.74	11.47	17.21	22.94
Soya beans	24.00	24.00	24.00	24.00	24.00
Wheat offal	14.00	14.00	14.00	14.00	14.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Blood meal	2.00	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25	0.25
*Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00	100.00
Calculated Nutrients					
Crude protein	18.28	18.13	17.82	17.71	17.63
Metabolizable energy (KCal/Kg)	2,550	2,535	2,510	2,472	2,460

**Premix contents per kg: V itamins A 10000IU, vitamin B 2000IU, vitamin E 13000IU, vitamin K1500mg, vitamin B12 10mg, Riboflavin 500mg, Pyridoxine 1300mg, Thiamine 1300mg, Panthothenic acid 800mg, Nicotinic acid 2800mg, Folic acid 500mg, Biotin 400mg, Copper700mg, Manganese 4800mg, Iron 5800mg, Zinc 5800mg, Selenium 129mg, Iodin e 60mg, Cobalt 300mg, Chlorine 27500mg*

Cost of Weight Gain (₦) = Average Weight Gain (kg) x Cost of Feed ₦/kg Weight Gain

Cost of Feed (₦)/kg Weight Gain= Cost of feed (N/kg) x Average Feed consumed (kg) / Average Weight Gain (kg)

Relative Cost Benefit (%)

= Cost of feed (N/kg) Weight Gain of Control Diet - Cost of feed (N/kg) Weight of Test Diet / Cost of feed (N/kg) Weight Gain of Control Diet x 100

Total Cost (₦) = Total Fixed Cost (TFC) + Total Variable Cost (TVC)

Cost Differential= Cost of Feed ₦/kg Weight Gain of Control–Cost of Feed ₦/kg Weight Gain of Test Diet

Results and discussion

The result of growth performance of rabbits fed diets with maize replaced with kolanut testa meal is presented in Table 2. The result reveals that non-significant ($P>0.05$) differences were recorded in the all parameters measured showing that the replacement of maize with kolanut testa has no deleterious effect on the growth performance of rabbits.

Table 2: Growth performance of rabbits fed diets with maize replaced with kolanut testa

Parameters	Percentage inclusion of kolanut testa					SEM	SIG
	0	10	20	30	40		
Initial body weight (g)	816.67	750.00	733.33	766.67	600.00	93.99	0.59
Final live weight (g)	1600.67	1593.33	1583.33	1500.00	1516.67	103.54	0.93
Total weight gain (g)	783.33	843.33	850.00	733.33	916.67	150.47	0.90
Daily weight gain (g)	13.99	15.06	15.18	12.80	16.37	2.69	0.90
Total feed consumed (g)	4007.67	4419.00	4054.00	4638.67	4784.67	367.42	0.51
Daily feed consumed (g)	71.56	78.91	72.39	82.83	85.44	6.56	0.51
Feed conversion ratio	5.55	6.61	4.88	6.55	5.32	1.21	0.80

SEM: Standard Error Mean

This is similar to the report of Jiya *et al.* (2012) who recorded non-significant (P>0.05) differences in all the parameters used to measure growth performance of rabbits fed diets of maize replaced with Kolanut Husk Meal (KNM) up to 20%. However, total (916.67g) and daily weight gain (16.37g) proved to be numerically higher at 40% than in the other treatment groups despite it having the lowest initial body weight (600.00g). This disagrees with the report of Abioye *et al.* (2006) who recorded significant decrease (P<0.05) in weight gain up to 200g/kg inclusion of KHM in broiler diet. This can be attributed to the fact that rabbits can easily use protein inside cellulose rich feeds than poultry (Lebas, 1983). Total (4784.67g) and daily feed consumed (85.44g) were likewise numerically higher at 40% than in the other treatment groups. From the result, rabbits fed diets with kolanut testa consumed more feed (4054.00-4784.67g) than rabbits that consumed feed with conventional ingredients only (4007.67g). Although no significant difference(P>0.05) was recorded, this result agrees with that of Olalokun and Olalokun (1999), who reported improved body weight gain and feed intake for rabbits fed KHM. Feed conversion ratio is however lowest at 20% replacement and highest at 10% replacement of maize with KOT meal.

Table 3: Carcass characteristics of rabbits fed diets with maize replaced with kolanut testa

Parameter	Percentage inclusion of kolanut testa					SEM	SIG
	0	10	20	30	40		
Final live weight (kg)	1.60	1.60	1.58	1.50	1.52	0.12	0.87
Slaughter weight (kg)	1.40	1.38	1.50	1.43	1.43	0.13	0.97
Dressed weight (kg)	1.13	1.07	1.13	1.13	1.12	0.93	0.98
Eviscerated weight (kg)	0.90	0.67	0.87	0.93	0.67	0.12	0.39
Trunk weight (g)	370.73	356.70	408.47	367.60	368.33	26.12	0.69
Head (g/kg)	132.63	124.20	148.40	140.60	133.30	10.68	0.59
Pelt (g/kg)	148.43	129.90	154.10	168.13	134.23	20.39	0.69
Limbs (g/kg)	24.43^{b}	29.90^{ab}	32.17^{a}	34.00^{a}	30.23^{ab}	2.18	0.04
Tail (g/kg)	5.17	5.97	5.30	4.13	5.03	1.61	0.04
Neck (g/kg)	30.33	25.73	29.53	37.53	30.07	5.16	0.62
Thigh (g/kg)	271.40	264.97	276.97	288.73	288.77	24.90	0.94
Loin (g/kg)	146.07	145.90	177.43	163.10	150.23	13.35	0.43
Forequarter (g/kg)	239.30	229.30	258.00	269.93	272.97	30.20	0.81
Shoulder (g/kg)	107.80	102.70	120.93	127.87	107.57	8.27	0.24
Ribs (g/kg)	125.00	127.07	135.53	138.07	130.90	12.09	0.93
Carcass length (cm)	32.33	31.33	31.33	33.00	33.67	0.83	0.27

[a,b]: Mean values with different superscript along the same row indicate significant difference (P<0.05).
SEM: Standard Error of Mean

The result of the carcass characteristics of rabbits fed diets with maize replaced with KOT meal as shown in Table 3 reveals that no significant difference (P>0.05) was recorded in final live weight (1.50 – 1.60kg), slaughter weight (1.38 – 1.50kg), dressed weight (1.07 – 1.13kg), eviscerated weight (0.067 – 0.93kg), trunk weight (367.60 – 408.47kg), head (124.20 – 148.40g/kg), pelt (129.90 – 168.13g/kg), tail (4.13 – 5.97g/kg), neck (25.73 – 37.53g/kg), thigh (264 – 288g/kg), loin (145.90 – 177.43g/kg), forequarter (229.30 – 272.97 g/kg), shoulder (102.70 – 127.87g/kg), ribs (125.00 -138.53g/kg) and carcass length (31.33 – 33.67cm). The final live weight decreased numerically with increase in the inclusion of KOT. This can

be attributed to similar trend in the initial weight. This result is also similar to the decrease in weight gain (P<0.05) with increased level of KHM in broiler diets reported by Abioye *et al.* (2006). This proves that the replacement of maize with kolanut testa has no negative effect on these various parts of the rabbits. However, significant (P<0.05) differences were recorded in the weights of limbs and this can be attributed to losses during processing. This is however contrary to the report of Jiya *et al.* (2012) who recorded no significant difference (P>0.05) in the weights of hind limbs of rabbits fed KHM.

Table 4 : H aematological parameters of rabbits fed diets of maize replaced with kolanut testa

Parameters	Percentage inclusion of kolanut testa					SEM	SIG
	0	10	20	30	40		
ESR(mm/hr)	2.33	2.67	3.33	1.67	2.00	0.68	0.53
PCV (%)	28.67^{ab}	36.33^{a}	29.67^{b}	31.33^{ab}	30.33^{ab}	1.91	0.04
RBC($x10^6/mm^3$)	3.14^{b}	3.41^{ab}	3.54^{ab}	4.12^{a}	3.72^{ab}	0.81	0.04
WBC($x10^3/mm^3$)	3.67^{b}	5.87^{a}	3.10^{b}	4.33^{ab}	4.60^{ab}	1.31	0.31
Hb (g/dl)	9.53	11.00	9.97	10.20	9.97	1.40	0.37
Lym (%)	59.00	58.33	58.67	59.33	59.33	0.69	0.81
Neu (%)	23.67	23.67	22.00	22.33	23.33	0.75	0.41
Mon(%)	1.40^{b}	1.67^{a}	1.50^{ab}	1.50^{ab}	1.40^{b}	0.65	0.40
Eos (%)	2.67	2.33	2.33	2.00	2.67	0.30	0.51
Bas (%)	0.67	0.63	0.67	1.00	0.67	0.30	0.66
MCV(fl)	91.30	106.54	83.81	76.04	81.53	-	-
MCH(Pg)	30.35	32.26	28.16	24.76	26.80	-	-
MCHC(%)	33.24	30.28	33.60	32.56	32.87	-	-

^{a,b,c} means with different superscript across the row shows significant difference (P<0.05) among the treatment.
ESR=Erythrocyte Sedimentation Rate, PCV=Pack Cell Volume, RBC=Red Blood Cell, Hb=Haemoglobin Concentration, MCV=Mean Corpuscular Volume, MCH=Mean Corpuscular Haemoglobin, MCHC=Mean Corpuscular Haemo globin Concentration, Lym=Lymphocyte, Neu=Neutrophil, Mon=Monocyte, Eos=Eosinophil, Bas=Basophil.

The result on Table 4 reveal that no significant difference (P>0.05) exist among means of ESR (1.67-3.33mm/hr), Hb (9.53-10.20g/dl), Lym (58.00-59.33%), Neu (22.00-23.67%), Eos (2.00-2.67%), Bas (0.63-1.00%). Significant differences (P<0.05) were however recorded among the mean values of PCV (28.67-36.33%), RBC ($3.14\text{-}4.12x10^6/mm^3$), WBC ($3.10\text{-}5.87x10^3/mm^3$) and Mon (1.40-1.67%). Although PCV (36.33%), WBC ($5.87x10^3/mm^3$) and Mon (1.67%) values of Treatment 2 are numerically higher than others, all recorded mean values of haematological parameters measured in this study fall within normal ranges according to the reports of Chineke *et al. (*2006), Olabanji *et al*. (2007) and Togun *et al*. (2007).

The MCV, MCH and MCHC values for treatments 1, 3, 4 and 5, respectively fell within the normal range for rabbits according to Research Animal Resources (2009). However, MCV (106.54fl) and MCHC (30.28%) values of treatment 2 deviates from the normal range thereby suggesting that rabbits fed diet containing maize replaced with KOT at 10% may suffer an anaemic condition.

Table 5: Economics of production of rabbits fed diets of maize replaced with kolanut testa

	Percentage inclusion of kolanut testa				
	0	**10**	**20**	**30**	**40**
Purchase Price (fl)	1450.00	1520.00	1500.00	1580.00	1600.00
Average weight gain (kg)	0.56	0.70	0.69	0.76	0.83
Average feed consumed (kg)	4.1	4.3	4.0	4.1	4.3
Cost items					
Cost of cage maintenance (fl)	250	250	250	250	250
Cost of feed (fl /kg)	139.81	133.11	126.17	119.35	112.54
Cost of feed (fl)/kg weight gain	1023.61	817.68	731.42	643.86	583.04
Cost of weight gain (fl)	573.22	572.38	504.68	489.33	483.92
Total cost (fl)	2143.61	1917.68	1801.42	1743.85	1523.92
Cost differential	-	205.93	292.19	379.75	440.04
Relative cost benefit (%)	-	20.11	28.54	37.10	43.04

The result of the economics of production as shown in Table 4 reveals that cost of feed (fl /kg) decreased with increase in the inclusion of KOT (fl 139.81-fl 112.54). Cost of feed (fl /kg) weight gain (fl 1023.61-fl 583.04); cost of weight gain (fl 573.22-fl 483.92); total cost (fl 2143.61-fl 1523.92) all followed similar pattern. Cost differential (205.93–440.04) and relative cost benefit (20.11–43.04%) increased with increase in the inclusion level of KOT. The best relative cost benefit was however recorded at 40% replacement of maize with KOT meal.

Conclusion

This study revealed that the growth performance of the experimental rabbits was similar. However, total weight gain was numerically highest at 40% kolanut testa (916.67g) with no recorded deleterious effect on the health of the rabbits. Also, the highest relative cost benefit was recorded at 40% KOT (28.54%). These prove that KOT is a viable substitute for maize in rabbit diet up to 40%.

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