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Original Research Article

Replacing Dietary Maize with Kolanut Husk Meal can Influence Growth Performance and Apparent Nutrient Digestibility of Rabbits

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Abstract

This study was carried out to investigate the growth performance and nutrient digestibility of weaned rabbits fed different levels of dietary kolanut husk meal (KHM). The feeding trial lasted for 8 weeks and was carried out using 40 crossbred rabbits with the sex ratio of 1:1 (male:female). The rabbits were randomly allotted to five treatments containing maize replaced with KHM at 0, 20, 40, 60 and 80% levels and designated as T_1, T_2, T_3, T_4 and T_5 respectively, in a completely randomized design (CRD). Data were collected on feed intake, weight gain and nutrient digestibility and subjected to one – way ANOVA. Results indicated that there were significant ($P<0.05$) differences in final body weight (725 – 950 g/rabbit) and total weight gain (188.75 – 426.25 g/rabbit) across the treatments. The total feed intake (438.49 – 439.93 g/rabbit) did not record any significant difference between dietary treatments. The growth parameters were adversely affected at levels beyond 40% KHM. The digestibility of all nutrients (digestible crude protein, crude fibre, ether extract, dry matter, NFE and ash) were significantly ($P<0.05$) reduced compared to the control, especially at levels >40% KHM. This study concludes that replacing dietary maize with ≤40% KHM may not adversely influence growth performance and nutrient digestibility of rabbits. However, levels beyond 40% are not recommended in view of the apparent danger on the animals.

Keywords: Caffeine, non – conventional feedstuff, rabbits, utilization

INTRODUCTION

The major recurrent cost of rabbit production is feed; this alone has progressively taken the larger scale of the cost of production such that total feed cost accounts for over 60-80% of the production cost (Balogun *et al.,* 1992). Hence, the need to focus on least cost (cost effective) feeding system through the use of unconventional feed stuffs. Conventional feed ingredients such as maize used in rabbit feeding are becoming increasingly expensive due to competition from humans (FAO, 2002, Ozung *et al.,* 2017).

Rabbits are monogastric-herbivores which feed on forages, grains, and hay (Aduku and Olukosi, 1990); agro- by products like cassava peel meal (Ozung *et al*., 2011) and cocoa pod husk meal (Ozung, *et al*., 2017). Rabbits are micro-livestock, small bodied animals reared for meat and other by-products. They play an important role in meeting the protein needs of man. Rabbits have short breeding cycle (about 30-33days) and exceed ruminants in terms of growth and rank close to modern broiler chickens (Ologhobo *et al.,* 1992). Rabbits

supersede other animals because of their biological qualities like prolificacy and high feed efficiency, especially feedstuffs that are not directly utilized by man. Due to the increased number of people involved in rabbit production (*Cuniculture*) and high feed costs which have hampered large scale rabbit production, it has become imperative to develop appropriate and cost-effective feeding systems for backyard and commercial producers of rabbit. Inadequate supply and high cost of concentrate feed ingredients due to competition between man and monogastric animals are the major constraints for the development of rabbit industry in Nigeria (Agunbiade *et al.,* 2000). Many agricultural by-products (wheat offal, rice offal, maize bran and kolanut husk pod) that are considered as wastes in Nigeria have great potential as feed ingredients if properly handled, processed and incorporated into rations (NRC, 1984).

Kolanut (*Cola acuminata*) is a small ever-green African tree cultivated in the tropics (Duke, 2001). Kolanut is a stimulant that contains about 1.5 - 2% caffeine plus theobromine (Jayeola, 2001). The caffeine acts as a bronchodilator, expanding the bronchial air passages while the theobromine increases cerebral circulation (Jayeola, 2001). The husk contains high crude fibre (7.13%), crude protein (13%) and gross energy (2,546.9 Kcal/kg) (Oluokun and Olalokun, 1999). An earlier study showed that the inclusion of kolanut husk meal (KHM) at five levels (0, 50, 100, 150 and 200 g/kg) in the diet of broiler chickens, resulted in a reduction in weight gain and feed /gain ratio. Furthermore, kolanut husk meal decreased nitrogen retention, dry matter, ether extract and ash apparent digestibility of the while crude fibre digestibility increased. No significant effect was recorded for feed intake but protein intake and protein efficiency ratio decreased with increased KHM in the diets. Cost of feed reduced with increased KHM level but the cost of feed per kg weight gain increased (Jumoke *et al*., 2006).

Kolanut husk contains anti-nutrients such as caffeine, kolanin and theobromine (Okoli *et al*., 2012). Anti-nutritional factors are described as substances that block or inhibit important metabolic pathways, especially digestion (Theil *et al*., 1997). These substances are known to reduce bioavailability of many nutrients such as proteins, vitamins and minerals. For example, minerals and trace elements are inefficiently and variably absorbed from diets due to many factors including anti-nutrients such as phytates, oxalates, tannins and cyanides in (Kolawole *et al*., 2013).

Since kolanut husk meal (KHM) is a by-product of kola, it is believed that it contains some quantity of bioflavonoids which can improve growth rate (Solomon *et al.,* 2014). Hence, kolanut husk meal has high potential for consideration as possible substitute for conventional feed stuff such as maize. The nutritive value of kolanut husk necessitates its use in the nutrition of rabbits. This study was therefore designed to evaluate the growth performance and nutrient digestibility of rabbits fed kolanut husk meal as replacement for maize.

MATERIALS AND METHODS

Location of study

The study was carried out at the Rabbitry Unit of the Teaching and Research farm, University of Calabar, Calabar, Cross River State. Calabar is located within the tropical rainforest zone of Nigeria at latitude 4.96 and longitude 8.33(decimal degrees) and it is situated at 98 meters above sea level (Maplaudia.com) It has an average daily maximum temperature of 38.83^0C with average rainfall of 273.93mm per annum and relative humidity of 85.92% (NMA, 2018).

Collection and processing of test ingredient (Kolanut husk meal)

Freshly broken kolanut pod husks were collected from local farmers at Akpabuyo Local Government Area of Cross River State, Nigeria. The broken pods were washed in clean water and sundried for two (2) weeks to constant weight after which they were bulked and milled to obtain kolanut husk meal (KHM) (Teguia *et al.,* 2004).

Experimental animals and management

A total of 40 cross bred weaned rabbits (5 - 6 weeks old) of both sexes (20 bucks and 20 does) were used in the study. The rabbits were sourced from the rabbitry of Department of Animal Science, University of Calabar. They were managed based on standard experimental procedures in wooden cages. The rabbits were allowed to adjust to the rabbitry facility for two (2) weeks, and within this period they were placed on control diet before the commencement of the feeding trial which lasted for 8 weeks.

Experimental diets

Five (5) experimental diets were formulated containing kolanut husk meal (KHM) as replacement for maize at 0, 20, 40, 60 and 80% levels representing dietary treatments T_1, T_2, T_3, T_4, and T_5 respectively. Treatment (T_1) served as the control diet without kolanut husk meal. The gross composition of the experimental diet is represented in Table 1.

Table 1. Composition of experimental diets

	T_1	T_2	T_3	T_4	T_5
		Levels of KHM replacement			
Ingredients	**0%**	**20%**	**40%**	**60%**	**80%**
Yellow	45.00	36.00	27.00	18.00	9.00
Kolanut husk	0.00	9	18.00	27.00	36.00
Soy bean meal	16.00	16.00	16.00	16.00	16.00
Rice husk	18.00	18.00	18.00	18.00	18.00
Palm kernel meal	8.00	8.00	8.00	8.00	8.00
Wheat offal	10.00	10.00	10.00	10.00	10.00
Cry fish dust	1.0	1.00	1.00	1.00	1.00
Palm oil	1.00	1.00	1.00	1.00	1.00
Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Bone meal	0.50	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
Crude protein (%)	15.62	15.98	16.34	16.70	17.06
Crude fibre (%)	8.49`	8.95	9.41	9.87	1.33
ME (Kcal/kg)	2599.20	2519.72	2440.24	2360.76	2281.28
Determined values:					
% CP	15.00	15.26	16.62	16.75	16.80
%CF	9.75	14.32	18.50	22.50	25.30

T_1: Control diet (0% KHM)
T_2: 20% KHM replacement for maize
T_3: 40% KHM replacement for maize
T_4: 60% KHM replacement for maize
T_5: 80% KHM replacement for maize
KHM: Kolanut husk meal

Housing and equipment

The rabbits were housed individually in wooden cages (with wire mesh floor) measuring 65×65×65cm (L x H x W) and raised 25cm from the ground level and placed in a standard rabbitry. Basic drinking and feeding troughs were provided during the feeding trial period.

Experimental design

Animals were assigned to the test diets using a Completely Randomized Design (CRD). Eight (8) rabbits were allotted to each dietary treatment, with each rabbit serving as a replicate after balancing for body weight.

Feeding and weighing of animals/body weight changes

The rabbits were weighed individually at the beginning of the study and thereafter, on a weekly basis for weight gain throughout the period of 60 days. A top loader weighing scale was used and the weight gain was obtained by difference.

Feed intake

The rabbits were fed experimental diets between 7 and 8am daily. Clean drinking water was also provided *ad-libitum*. Left over feed was collected into clearly labeled envelops and weighed daily with a precision electronic balance. The feed intake was computed by difference. Supplementary forage (*Tridax procumbens*) was air dried and provided in uniform quantity in the evening period to all rabbits.

Feed conversion ratio

The parameter used to assess feed efficiency was feed/grain ratio, calculated as the ratio of feed intake (g) to live weight gain (g).

Digestibility trial

This is an important measure of the nutritive value between the feed consumed and materials voided by the animal expressed as percentage of feed eaten. The digestibility trial lasted for 15 days using 8 rabbits per

Table 2. Growth performance characteristics of weaned rabbits fed kolanut husk meal-based diets

	T_1 0%	T_2 20%	T_3 40%	T_4 60%	T_5 80%	SEM
Initial weight (g/rabbit)	523.75	511.25	518.75	536.25	523.75	4.08
Finial weight (g/rabbit)	950.00^{a}	933.33^{a}	907.50^{a}	725.00^{b}	766.69^{b}	46.15
Total weight gain (g/rabbit)	426.25^{a}	422.08^{a}	388.75^{b}	188.75^{c}	242.92^{bc}	49.32
Total feed intake (g/rabbit)	439.93	438.49	439.25	439.20	439.12	0.23
FCR	1.03^{b}	1.04^{b}	1.13^{b}	2.33^{a}	1.81^{b}	0.26
Mortality (%)	12.50^{c}	25.00^{b}	25.00^{b}	25.00^{b}	37.50^{a}	3.95

$^{a, b, c}$Means of the same row with different superscripts are significantly different (P< 0.05)
FCR: Feed conversion ratio

Table 3. Apparent nutrients digestibility of weaned rabbits fed kolanut husk meal-based diets

Parameter (%)	T_1 0%	T_2 20%	T_3 40%	T_4 60%	T_5 80%	SEM
Digestible DM	90.08^{a}	88.23^{b}	81.95^{c}	84.69^{d}	89.02^{ab}	1.51
Digestible CP	16.33^{a}	12.71^{b}	10.43^{c}	8.36^{c}	9.23^{c}	2.17
Digestible EE	74.06^{a}	68.41^{b}	60.88^{c}	41.76^{d}	34.62^{d}	4.63
Digestible CF	57.23^{a}	28.63^{b}	18.27^{c}	18.09^{c}	20.51^{c}	7.42
Digestible Ash	96.46^{a}	68.40^{b}	49.86^{c}	19.65^{d}	22.33^{d}	14.45
Digestible NFE	84.99^{a}	89.27^{b}	88.73^{b}	80.33^{c}	84.18^{d}	1.63

$^{a, b, c, d}$Means of the same row with different superscripts are significantly different (P< 0.05)
DM: Dry matter
CP: Crude protein
CF: Crude fibre
NFE: Nitrogen free extracts

treatment in metabolic cages. Faeces were collected on the last seven days at the sixth week. Faeces were oven dried at 60^{0}C and preserved in plastic bags before storing in a refrigerator. At the end all faecal samples collected from each replicate were pooled and samples taken for apparent nutrient digestibility determinations.

$$\% \text{ Apparent Nutrient Digestibility} = \frac{\text{Quality in feed - Quality in faeces}}{\text{Quantity in feed}} \times 100$$

Statistical analysis

All data obtained from the study were subjected to one - way Analysis of Variance (ANOVA) for CRD. Significant means were separated using the Least Significance Difference (LSD) option (Steel and Torrie, 1980).

RESULTS

Growth performance characteristics

Results of the growth performance characteristics of weaned rabbits fed diets containing kolanut husk meal as replacement for maize are presented in Table 2. The results revealed that the range for total feed intake (439.12 – 439.93 g/rabbit) was not significantly different (P> 0.05) between dietary treatments, while final weight (725 – 950 g/rabbit), feed conversion ratio (1.03 – 1.81) and total weight gain (188.75 – 426.25 g/rabbit) were significantly (P<0.05) influenced by dietary treatments. Rabbits fed control diets had higher weight gain compared to those fed kolanut husk meal based diets. Rabbits fed the control diet had the least mortality (12.50%) compared to rabbits fed 80% KHM replacement, which had the highest mortality (37.50%).

Nutrient digestibility

Results of apparent nutrient digestibility of rabbits fed diets containing kolanut husk meal as replacement for maize are presented in Table 3. All digestibility parameters (digestible Ash, crude protein, ether extract, crude fibre, dry matter and nitrogen free extract) were all significantly (P<0.05) different between dietary treatments. The respective ranges were as follows: digestible DM (81.95 – 90.08%), digestible CP (8.36 –

16.33%), digestible EE (34.62 – 74.06%), digestible CF (18.09 – 57.23%), digestible Ash (19.65 – 96.46%) and digestible NFE (80.33 – 89.27%). The control diet recorded highest digestibility coefficients than the KHM based diets which had low and poor digestibility values.

DISCUSSION

Growth performance characteristics of rabbits fed KHM as a replacement for maize

The results of growth performance characteristics showed significant differences ($P<0.05$) in the final weight of rabbits. The control diet (T_1) had the highest value of 950 g/rabbit while the KHM based – diets had lower values. The range for average final weight was 725 – 950 g/rabbit, which was less than the range 1005.00 – 1144.30 g/rabbit reported by Adeyina *et al.* (2010) who fed hot water treated cocoa bean shell meal to rabbits. The difference may be attributed to differences in age and breed of rabbits as well as test ingredients used in the separate studies. The total weight gain was significantly affected ($P<0.05$) with increased levels of KHM in the diets. Diet T_4 (80% KHM) had the least value of 188.75 g/rabbit while T_1 (0% KHM) had the highest value of 426.25g/rabbit. The result is agreement with the report of Eniola *et al*. (2006) who observed that higher levels of KHM affected the growth of animals fed graded levels of kolanut husk meal based - diet. The decrease in total weight gain from this study could have been as a result of high CF content of KHM, caffeine and tannin which has been reported to produce depressive effect on growth rate of rabbits (Babatunde *et al*., 2001). The total feed intake observed in the treatments showed no significant ($P>0.05$) difference between rabbits on the control diet and those on diets containing the test ingredient although the control group had the highest value (439.93 g/rabbit). The feed intake was not affected with increased levels of KHM, this was in line with Oluokun and Olalokun (1999) who reported improved weight gain but absence of effect on feed intake for rabbits fed KHM diets. The feed conversion ratio in this study was between 1.03 and 2.33. The control diet had the best FCR compared with the KHM diets. The poor efficiency in the KHM diets could be attributed to the high replacement levels of KHM for maize in this study. The high levels of KHM implied higher crude fibre which has been reported to reduce feed efficiency (Gidenne *et al*., 2000, Ozung, 2016; Ozung *et al*., 2017).

Apparent nutrient digestibility

The apparent nutrient digestibility (Table 3) showed a common trend of significant ($P<0.05$) between dietary treatments for all parameters. There was a steady decline in apparent digestibility across all dietary levels as the replacement levels of KHM increased. The digestibility coefficients in this study were generally low for the HKM diets compared with the control diet, implying that the rabbits were unable to properly utilize nutrients in the diets for their growth. This could be explained by the depressive effect of fibrous constituents on nutrient digestibility, residual caffeine and other anti-nutrients in KHM (Hamzat and Adeola, 2011). The extent of reduction in digestibility has been shown to vary with the level of fibre and feeding level (Ravindran, 1990). Kolanut husk meal is relatively fibrous and it could be responsible for depression in nutrient utilization as it impaired digestion and absorption of nutrients. The reduction in nutrient digestibility could also be explained by the reduction in mean retention time of feed in the digestive tract (Marcel *et al*., 2011). The ranges for apparent nutrient digestibilty in this study for dry matter (81.95 – 90.08%), crude fibre (18.09 – 57.23%), crude protein (8.36 – 16.33%), ether extract (34.62 – 74.06%), ash (19.65 – 96.46%) and NFE (80.33 – 89.27%) were fairly lower than the ranges reported for rabbits fed cocoa pod husk meal based- diets by Ozung (2016) for digestible dry matter (95.41 – 96.34%), digestible crude fibre (61.14 – 85.97%) and digestible crude protein (72.18 – 78.54%). The differences in digestibility values could be attributed to age disparity of the rabbits, different feeding materials used as test ingredients, processing methods and associated fibre levels in the separate studies. Furthermore, results obtained showed that protein digestibility did not improve significantly as the KHM replacement levels increased in the diets. This may be attributed to the insoluble fibre in the Kolanut husk meal which did not allow for effective digestion, as insoluble fibre can be further fermented in the caeca of rabbits to derive more protein and vitamins through coprophagy or caecotrophy (Oduguwa *et al*., 1999).

CONCLUSION

The results of this study have revealed that the feeding value of kolanut husk meal (KHM) is low and replacing maize with KHM at levels beyond 40% could pose detrimental effects on the growth performance and apparent nutrient digestibility of rabbits.

RECOMMENDATIONS

Based on the outcome of this study, it is therefore recommended that farmers can replace maize with kolanut husk meal at levels lower tha 40% when compared with the control diet for optimum growth and nutrient digestibility. Further research may be necessary to enhance the feeding value of KHM for rabbits through

other processing methods like fermentation, urea treatment or use of enzymes as feed additives.

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