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EFFECT OF SUPPLEMENTARY LYSINE ON PERFORMANCE AND CARCASS CHARACTERISTICS OF GROWER RABBITS FED COTTON SEED BASED DIETS

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ABSTRACT

A study was conducted to evaluate the possibility of feeding varying levels of lysine to a cotton seed meal (CSM) based diet. Twenty five rabbits of mixed breeds and sexes were used in a completely randomized design for this study. The rabbit were divided into 5 treatments groups, with 5 rabbits replicated per group in a completely randomized design. Five isonitrogenous experimental treatment diets were formulated with different inclusion levels of lysine. Diet 1, the control diet, had no CSM. Diets 2 to 5 had 25% CSM each, with a supplemental lysine content of 0, 0.6, 0.8 and 1%, respectively. The performance of rabbits fed CSM based diets containing varying levels of lysine showed significant ($P<0.05$) difference in the parameters studied. The control had the highest weight gain. While rabbits fed CSM based diet with 0% inclusion of lysine had the lowest weight gain. Average daily weight gain, showed no significance difference ($P>0.05$) between treatment groups fed lysine supplemented CSM based diets, having average daily weight gain ranging from 6.35g to 7.05g compared to the rabbits fed CSM based diet with no lysine supplementation recording 4.60g. The result of the feed conversion ratio (FCR) showed that the control diet had significantly ($P<0.05$) better FCR of 5.59, while the CSM based diet with no lysine supplementation had poorer FCR (8.79). The result of the slaughter weight showed rabbits fed the control diet had significantly ($P<0.05$) higher weight, when compared with those on the CSM based diets. Cut parts (chest, loin and thigh) were significantly ($P<0.05$) higher in the control group, while those fed CSM based diets with no lysine supplementation had the least. The result of the cost analysis showed an increase in the price of the diet with increase in the level of lysine, from ₦45.10 to ₦50.60/kg. Apparent profit of the control group fed on non CSM based diet was better (₦30.57), while those fed the CSM based diet without lysine supplementation yielded a negative apparent profit (₦23.56). Supplementation with lysine resulted in an apparent profit of ₦2.51. Also increasing the level of lysine resulted in an increase in the apparent profit of ₦9.92 at 1.0% lysine inclusion. From the result of this study, it can be recommended that when CSM based diet is to be fed, supplementary lysine should be included in the diet of rabbits. Increasing the level of lysine up to 1% has a significant effect on the performance of rabbits and income accruing to the farmers, when feeding CSC based diet to rabbits.

Keywords: Cottonseed cake, Cost, Lysine, Performance, Rabbits

INTRODUCTION

The increasing population of the world especially in the developing countries where average income and standard of living are the result in high rate of malnutrition among the populace. There is a great need for provision of cheap and affordable animal protein as most people in these countries cannot afford the cost of conventional animal proteins. Rabbit (*Oryctolaguscuniculus*)

described as a micro livestock species. they occupies a unique niche in that it is a micro livestock that is easy to manage by women and children, highly prolific and has a short generation interval species (Adeyemi *et al*., 2008). Rabbits also matures early, their meat has high protein, low fat, low energy and low cholesterol (Biobaku and Oguntona, 1997). Although rabbits can be raised on forage based diets, the poor quality of grasses, and availability of forages are major constraints limiting the successful production of rabbit in Nigeria.

Cheek and Raharjor (1988) reported that tropical grasses were unsuitable as the sole feed for rabbits due to the low digestibility (less than 10%) of the forage. Due to their small size and high metabolic rate, high quality forage is needed by rabbit feeding (Iribeck, 2001). Rabbits need highly nutritive diets since they breed all year round.

The principal sources of plant proteins in rabbit concentrate diets are soya bean meal (SBM) and groundnut cake (GNC). These plant protein sources also constitute major food items for human. There is therefore competition between man and animals for these foodstuffs. This competition has made the conventional feed stuff expensive thereby necessitating the use of available unconventional feed stuffs as alternatives. Several oil seed cakes have been investigated as alternative feedstuffs, and cottonseed meal (CSM), a by-product of the extraction of cottonseed oil, is one of them. The cake is rich in protein (42% CP) but contains the anti-nutritional factor, gossypol. This chemical is the major pigment in cottonseed which is toxic to non-ruminant animals and has limited the use of cotton seed meal (CSM) as a dietary source of protein for monogastric animals (Taha *et al*., 2006).

The objective of this study is to evaluate the performance, carcass characteristics and cost analysis of feeding grower rabbits with cotton seed cake based diets supplemented with varying levels of lysine.

MATERIALS AND METHODS

Experimental site

The experiment was conducted at the Rabbit Research Unit of the Department of animal Science, Ahmadu Bello University, Zaria, located in the Northern Guinea Savannah of Nigeria, on latitude 11^0 12´ N and longitude 7^0 33´ E at 610m above sea level (Ovimaps, 2017). I has an annual rainfall of 1100-1200mm and temperature that fluctuates within the range of 14.5-39.5^{0}C (IAR, 2017).

Experimental Design

Twenty five weaner rabbits of mixed breeds and sexes were used for this study. The rabbits were randomly divided into 5 treatment groups, with 5 rabbits per group. The rabbits were housed in individual wire cages, provided with feed and water troughs. The experimental animals were allowed to adjust to the experimental site and pen for a period of 10 days before the experiment commenced. Before the commencement of the experiment, the animals were treated with Ivomec (Ivomectin^R) against internal and external parasites and long acting Antibiotics (Tetracycline LA) against bacterial infection according to manufacturers' recommendations. Their initial weight was taken and balances before assigning them randomly into treatments.

Experimental Diets and Treatments

Five isonitrogenous diets with 16% CP were formulated with different inclusion levels of lysine in cotton seed meal based diets. Diet 1, the control diet, had no cotton seed meal and 0% inclusion level of lysine. Diets 2, 3, 4 and 5 each had CSM at 25% of the total diet. Diets 2, 3, 4 and 5 had supplemental lysine at 0.0, 0.6, 0.8 and 1%, respectively. Other ingredients in the diets included maize offals, corn cobs, brewers dried grains, palm kernel meal, groundnut cake, common salt, bone meal and dairy cattle premix (Table 1). Each experimental diet was taken to the laboratory and subjected to proximate analysis.

Table 1: Gross Composition of Experimental Diets containing inclusion levels of Lysine

Parameters	Control	Inclusion Levels of Lysine			
		0.00	**0.60**	**0.80**	**1.00**
Maize offals	33.00	35.00	34.40	34.20	34.00
Corn Cobs	25.00	10.00	10.00	10.00	10.00
Brewers Dried Grain	10.00	10.00	10.00	10.00	10.00
Palm kernel meal	15.00	15.00	15.00	15.00	15.00
Groundnut cake	15.00	3.00	3.00	3.00	3.00
Cotton seed	0.00	25.00	25.00	25.00	25.00
Bone ash	1.5	1.5	1.5	1.5	1.5
Common Salt	0.50	0.50	0.50	0.50	0.50
Premix Dairy Cattle	0.00	0.00	0.60	0.80	1.00
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated analysis					
Cost of feed N/Kg	45.1	45.4	48.5	49.8	50.6

Economic Analysis

Feed and rabbit meat costs were computed based on their market prices at the time of the experiment. Feed cost per kg live weight gain, feed efficiency, feed cost savings, dressing percent, were computed to arrive at the income accruable and apparent profit.

Laboratory analysis

Samples of the experimental diets were subjected to proximate analysis to determine dry matter (DM), crude protein (CP), ether extract (EE), crude fibre (CF) and ash using Kjeldahl (AOAC.2005) method. Nitrogen free extract (NFE) was determined by calculation.

Statistical Analysis

All data collected on voluntary feed intake, dry matter, organic matter intake, nutrient digestibility and nitrogen balance were subjected to analysis of variance using the procedure of SAS (2002).The Duncan's Multiple Range Test was used to separate the means as outlined in the

SAS package. The mathematical model used is as follows:

$$\mathbf{Y_{ijk} = \mu + T_i + e_{ij}}$$

Where:

Y_{ijk} = Dependent variable

μ= Overall means

T_i= Effect of the i^{th} inclusion level of lysine (control, 0.0, 0.6, 0.8, 1.0)

e_{ij}=Random error

RESULTS AND DISCUSSION

Proximate composition of experimental diets

The proximate compositions of the test ingredient and the experimental diets are shown in Table 2. The result shows that all the treatment diets had high dry matter (DM) content with a mean value of 91.0%. The crude protein (CP) content of all the diets were within the recommended level by (Aduku, 2004) for rabbits in tropics. The mean value of crude fiber across all the treatments has 17.42, which is within the recommended level by (Leng, 2008) that can also be tolerated by rabbits.

Table 2: Proximate Composition of Experimental Diets containing inclusion levels of Lysine

Parameters	Control	Inclusion Levels of Lysine			
		0.00	0.60	0.80	1.00
Dry matter	90.5	91.0	91.0	91.5	91.0
Organic matter	84.49	86.54	86.58	89.21	85.71
Crude protein	16.1	16.2	16.1	16.2	16.1
Crude fibre	17.10	17.56	17.50	17.50	17.46
Ether Extract	4.23	4.60	3.98	4.88	4.09
Ash	6.01	4.46	4.42	2.29	5.26
NFE	56.56	57.18	58.00	59.13	57.09

NFE=Nitrogen free extract

Effect of lysine inclusion on the performance of rabbits fed CSM based diets

The performance of rabbits fed cotton seed cake base diets containing varying levels of lysine are presented in Table 3. The result showed significant ($P<0.05$) differences in the parameters studied. There was no significance difference ($P>0.05$) between treatments containing different levels of lysine in final weight gain, but the control without inclusion of lysine had the highest weight gain. The superiority of the control diet can be attributed to protein quality (Heidarinia and Malakian, 2011). The rabbits fed CSM based diet with 0% inclusion of lysine had the lowest weight gain. This is also attributed to slight decrease in protein quality of CSM in the diet. Similar result has been reported by Heidarinia and Malakian (2011). Also, NRC (1996) reported that utilization of diet is usually high because of the percentage of protein.

The average daily weight gain of the rabbits fed lysine-supplemented CSM based diets showed no significant difference ($P>0.05$) between treatment groups. Their values ranged from 6.35g to 7.05g.The rabbits in these treatments had significantly ($P<0.05$) higher daily weight gains than those fed CSM based diet with 0% lysine, which had 4.60g. This agreed with the finding of Azman and Yilmaz (2005) who reported higher performance in chickens fed dietary CSM supplemented with lysine, and also Khadiga *et al*. (2009) who reported that addition of 1% lysine improved the growth rate and feed efficiency in chickens. However, the common trend in the result indicated relatively lower values in treatments groups as compared to the control (zero cottonseed, 0% inclusion of lysine), which could probably be due to the presence of residual gossypol in those diets that may have impaired the effective utilization of the test ingredient. This agrees with the findings of Abdulrashid *et al*. (2013), who in their work with chickens reported a reduction in performance due to residual effect of the gossypol.

The result of the feed conversion ratio (FCR) show that the control diet had significantly ($P<0.05$) better FCR of 5.59, than the other treatments. The CSM based diet with no lysine supplementation had poorer FCR (8.79), compared the other CSM based diets with lysine supplementation. The result showed that supplementation of CSM based diet with lysine significantly ($P<0.05$) improve the FCR. The result of this study agrees with the findings of Oluyemi and Roberts (1979) and Babatunde and

Fetuga (1976) reported a better feed conversion ratio as the quality of dietary protein improved.

Table 3. Performance of rabbits fed Cotton seed cake base diets containing inclusion levels of Lysine

Parameters	Inclusion Levels of Lysine					
	Control	0.00	0.06	0.80	1.00	SEM
Initial Weight(g)	853.80	854.00	853.00	853.50	854.00	12.34^{NS}
Final Weight(g)	1395.05^{a}	1111.66^{c}	1209.00^{b}	1210.32^{b}	1249.00^{b}	30.51
Total Weight Gain(g)	541.25^{a}	257.67^{c}	356.00^{b}	356.80^{b}	395.00^{b}	23.00
ADWG(g)	9.66^{a}	4.60^{c}	6.35^{b}	6.37^{b}	7.05^{b}	0.41
Total Feed intake(g)	432.08^{a}	321.98^{b}	316.41^{c}	315.08^{c}	345.55^{b}	11.85
Daily Feed Intake(g)	54.01^{a}	40.25^{b}	39.55^{c}	39.38^{c}	43.19^{b}	1.48
FCR	5.59^{a}	8.79^{c}	6.22^{b}	6.18^{b}	6.12^{b}	

$^{a, b, c,}$ Means along the same row bearing different superscript differ significantly (P<0.05);
SEM=Standard Error of Means; ADWG=Average daily weight gain; FCR=Feed conversion ratio

Effect of lysine supplementation on carcass characteristics

The result of the carcass analysis is presented in Table 4. The result show a significant (P<0.05) differences across the dietary treatments. The result of the slaughter weight showed that rabbits fed the control diet had significantly (P<0.05) higher weight than those fed the CSM based diets. The lower slaughter weight recorded in those fed the CSM based diet in this study is in line with the findings of Ilyas *et al*. (2007) who reported depressive effect of gossypol on growth. Supplementing with lysine did not significantly (P>0.05) differ across the CSM based diets, but numerically those supplemented with lysine were higher. The result of the weights after slaughter followed similar pattern.

The result of the cut parts (chest, loin and thigh) were significantly (P<0.05) higher in the control group, while those on CSM based with no lysine supplementation had the least. This is as a result of the poor utilization of the feed converting it to product (meat). This is in line with the reports of Oluyemi and Roberts (1979) and Babatunde and Fetuga (1976), that a better feed conversion ratio was observed as the quality of dietary protein improved.

Table 4: Carcass characteristics of rabbits fed cotton seedcake based diets with varying inclusion levels of supplementary lysine

Parameters	Control	Inclusion level of lysine				SEM
		0.00	0.6	0.8	1.00	
Slaughter weight	1176.7^{a}	970.0^{b}	1040.0^{b}	1010.0^{b}	1033.3^{b}	50.57*
Weight after slaughter	1146.7^{a}	933.3^{b}	1015.0^{b}	960.0^{b}	1006.7^{b}	49.82*
Carcass weight	516.67^{a}	406.67^{b}	425.00^{b}	375.00^{c}	446.67^{b}	26.7*
Dressing percentage	55.346^{c}	56.205^{c}	58.600^{b}	60.936^{a}	56.120^{c}	0.63*
Chest	180.00^{a}	120.00^{c}	125.00^{cb}	158.00^{b}	156.67^{b}	8.84*
Loin	110.00^{a}	56.67^{c}	90.00^{b}	89.00^{b}	76.67^{b}	7.33*
Thigh	176.67^{a}	136.67^{bc}	145.00^{b}	152.00^{b}	160.00^{ab}	8.95*

^{a,b,c} Means with different super script

Cost Analysis of Supplementing Lysine in CSM Based Diet

The result of the cost analysis of feeding rabbits CSM based diet with varying levels of supplementary lysine are presented in Table 5. The result showed an increase in the cost of the diet with increase in the level of lysine, from ₦45.10 to ₦50.60 per Kg. The increase is as a result of the price of the synthetic lysine, which is imported into the country. The performance indices: average daily weight gain, and the cost of daily feed consumed, are the indicators of economic performance (Ojebiyi *et al*., 2016), which translate to higher revenue and more profit.

Table 5. Cost Analysis of feeding rabbit with varying inclusion level of lysine in cotton seed meal based diets.

Parameters	Control	Inclusion level of lysine			
		0.00	0.60	0.80	1.00
Cost of rabbit meat	550	550	550	550	550
DRS%	56.12	55.60	56.21	58.34	60.93
Cost/kg diet (N)	45.10	45.40	48.50	49.80	50.60
ADFI	54.01	40.25	39.55	39.38	43.19
TFC (g)	3024.56	2254.0	2214.8	2205.28	2418.64
CDFC (N)	2.44	1.83	1.92	1.96	2.18
ADWG	9.66	4.6	6.35	6.37	7.05
TWG (g)	540.96	257.6	355.6	356.72	394.8
TCFC	136.41	102.33	107.42	109.82	122.38
Income Accruable (N)	166.97	78.77	109.93	114.46	132.30
Apparent profit (N)	30.57	-23.56	2.51	4.64	9.92

ADWG Average daily weight gain, TWG total weight gain, ADFI=Average daily feed intake, TFC=Total feed consumed, TCFC Total cost of feed consumed; CDFC Cost of daily feed consumed; N=Nigeria naira

The apparent profit of the control group (fed non CSM based diet)was higher (₦30.57) than those fed the CSM based diet without lysine supplementation, which hada negative apparent profit (₦23.56). Supplementation with lysine at 0.60 resulted in an apparent profit of ₦2.51. Increasing the level of lysine resulted in a marginal increase in apparent profit. This is as a result of depressive effect of the gossypol in the animals fed the CSM based diet without supplementation with lysine. Also increasing the level of lysine resulted in an increase in the apparent profit of ₦9.92 at 1.0% lysine inclusion. Supplementations with lysine resulted in improved performance and consequently, increase in revenue and profit. This agrees with the findings of Abdu *et al*. (2017), who reported improvement in performance of rabbits resulted in more revenue accruable to the farmer.

CONCLUSIONS

Following the result of this study, the following conclusions can be made:

Performance of rabbits fed CSM based diets is impaired by the presence of gossypol in the diet.

Inclusion of lysine in the diet of rabbits fed CSM based diet improved their performance and utilization of nutrients.

Increasing the level of lysine up to 1% improved the performance and profit margin of rabbits.

RECOMMENDATIONS

From the results of this study, it can be recommended that where CSM based diet is to be fed to rabbits, supplementary lysine up to 1% should be included in the diet of rabbits. Increasing the level of lysine up to 1% does not have adverse effect on the performance of rabbit. However, higher level above the 1% of inclusion of lysine could further be investigated as a means of ameliorating the effects of CSM on performance and cost analysis of feeding rabbits. Also local source of lysine should be exploited to save the cost of feed.

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