academicJournals

Vol. 8(48), pp. 6318-6322, 12 December, 2013
DOI: 10.5897/AJAR2013.7120
ISSN 1991-637X ©2013 Academic Journals
http://www.academicjournals.org/AJAR

African Journal of Agricultural Research

Full Length Research Paper

Effect of feeding graded levels of camel blood-rumen content mixture on nutrient digestibility and carcass measurement of growing rabbits

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Accepted 12 November, 2013

A ten-week feeding trial was conducted to investigate the effect of camel blood-rumen content mixture (CBRCM) on the nutrient digestibility and carcass measurement of cross-bred (Dutch x New Zealand) growing rabbits aged between five and seven weeks. Forty five rabbits were randomly allocated to five dietary treatments of nine per treatment in a complete randomized block design experiment. The CBRCM was included at 0, 10, 20, 30 and 40% levels in diets 1, 2, 3, 4 and 5 respectively. The response showed that the digestibility of dry matter, crude protein, crude fibre, ether extract and Total ash were significantly affected (P<0.05) by the test material in the diets but only nitrogen-free extract (NFE) digestibility was not significantly affected (P>0.05) by the test material in the diets. The slaughter weight, dressed weight, dressing percentage, rack, thighs, head, tail, skin, feet, heart, lungs, kidneys, caecum, large intestine, small intestine, stomach and body length were not significantly (P>0.05) different among the treatment groups. The shoulder, loin and liver were significantly (P<0.05) different amongst the treatment groups. The study indicated that CBRCM can be included in rabbit diet up to 40% inclusion level.

Key words: Growing rabbits, camel blood-rumen content mixture, nutrient digestibility, carcass characteristics.

INTRODUCTION

In Nigeria as in most developing countries the daily intake of animal protein (3.24 g) falls grossly short of the recommended 27 g animal protein per day (FAO, 1993). This observed low animal protein consumption may be attributed to the declining animal protein production as a result of high cost of livestock feed which usually accounts for up to 70% of total cost of production (Ijaiya and Awonusi, 2002). Therefore, effort targeted at reducing the cost of livestock feed should be possible remedies. The production of highly prolific and fast maturing animal such as rabbit can provide remedy for the shortage of animal protein for human consumption, because livestock like cattle, pigs, goat and sheep take longer period to mature (Ajayi et al., 2007).

Maize account for about 45% of the diet of rabbit, hence such price changes will induce a classic increase in the price of finished feed as reported by Adeniji (2008). There is need to research into the use of cheap and unconventional feed ingredients for compounding rabbits diets so as to boost rabbit production. One of such unconventional ingredient is blood-rumen content mixture which is by-products from abattoir and slaughter houses. Investigation had revealed the composition and potential of blood-rumen content mixture as a good source of protein in monogastric (Adeniji and Balogun, 2001). The study was aimed at determining the effect of feeding

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Table 1. Ingredients compositions of the diets.

Ingredients (%)	Level of CBRCM in the diets (%)				
	0	10	20	30	40
Maize	40.98	39.12	37.41	35.24	24.35
Wheat offal	17.00	17.00	17.00	17.00	17.00
CBRCM	0.00	10.00	20.00	30.00	40.00
Groundnut cake	23.37	15.23	6.94	0.00	0.00
Fish meal	3.00	3.00	3.00	2.11	3.00
Groundnut haulms	13.00	13.00	13.00	13.00	13.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Common Salt (NaCl)	0.50	0.50	0.50	0.50	0.50
Premix*	0.15	0.15	0.15	0.15	0.15
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

* Premix (grow fast) manufactured by Animal Care Service Consult (Nig) Ltd. Lagos, Supplied the following per kg of premix: Vitamin A, 5000,00 IU; Vitamin D_3 800,000 IU; Vitamin E, 12,000 mg; Vitamin K, 1,5000 mg; Vitamin B_1, 1,000 mg; Vitamin B_2, 2,000 mg, Vitamin B_6, 1,500 mg; Niacin, 12,000 mg; pantothenic acid, 20.00 mg; Biotin,10.00 mg; Vitamin B_{12}, 300.00 mg; folic acid, 150,000 mg; choline, 60,000 mg; manganese, 10,000 mg; iron;15,000 mg, zinc 800.00 mg; Copper 400.00 mg; Iodine 80.00 mg; cobalt 40 mg; selenium 8,00 mg. CBRCM= Camel blood-rumen content mixture.

camel blood-rumen content mixture on nutrient digestibility and carcass measurement of growing rabbits.

MATERIALS AND METHODS

Experimental animals and management

A total of forty five Dutch x New Zealand white rabbits, aged between five and seven weeks were used for the feeding trial which lasted for 10 weeks. Before commencement of the experiment, a one-week adjustment period was observed. During this period, the rabbits were treated against internal and external parasites by subcutaneous injection of Ivomec (0.2 ml/rabbit). The rabbits were individually weighed and divided into five groups. Each group was replicated thrice with three rabbits per replicate in such way to ensure uniformity of average weight and sex of each group (six males and three females per treatment). The groups were randomly assigned to five dietary treatments. Each rabbit was individually housed in a wire cage measuring 38 × 33 × 45 cm. The cages, in rows, were raised 45 cm above the ground to facilitate cleaning. Each cage cell was equipped with plastic drinkers and metal feeding troughs. The experimental diets (in mash form) and clean drinking water were provided *ad libitum* throughout the experimental period. A total of 100 g feed was supplied to each rabbit per day at rate 50 g in the morning (8.00 am) and 50% in the evening (3.30 pm)**.**

Source of camel blood-rumen content mixture

The camel rumen content was collected in Maiduguri abattoir. Blood was collected from camel in a clean container during slaughter and the blood and camel rumen content weighed in a ratio of 1:3 (that is, 1 kg of blood and 3 kg of rumen content) into a drum. The blood and the rumen content were mixed in the drum and boiled for 30 min with constant stirring to ensure a uniform mixture. The boiled camel blood–rumen content mixture was sun-dried for 5 days on a clean dry slab. The dried sample was ground with a hammer mill and analysed for proximate composition before inclusion into diets.

Experimental diets

The ingredient composition and the calculated analysis of the experimental diets are shown in Table 1. The camel blood–rumen content mixture was incorporated at levels of 0, 10, 20, 30 and 40% in diets 1 (control) 2, 3, 4 and 5 respectively. The diets were formulated to supply 19% crude protein (CP) and 2800-3000 K/cal of ME on dry matter basis.

Digestibility study

The nutrient digestibility study was conducted at the end of the week of the experiment. Faecal samples were collected from three rabbits per treatment (that is, one from each replicate) for a period of seven days using fine wire mesh trays placed under the cage cells. The amount of faeces voided daily was weighed and allowed to dry for 24 h at 80°C in an oven. The dried faecal samples were stored in air -tight bottles for chemical analysis. The proximate composition of the diets and faecal samples were determined according to AOAC (2000).

Carcass measurements

At the end of the experiment, three rabbits (one rabbit from each replicate based on average weight) from each treatment, were selected for slaughter. They were deprived of feed for 12 h as recommended by Joseph et al. (1994) but drinking water was provided. Withholding feed for 12 h before slaughter reduced the volume of gut contents and hence bacteria, and therefore reduced the risk of contamination of the carcass during dressing without adversely affecting meat yield and quality (FAO, 1991; Joseph et al., 1994). The rabbits were weighed in the morning and slaughtered by cutting transversely across the trachea, oesophagus, large carotid arteries and jugular veins to ensure maximum bleeding (Mann, 1960). They were later opened and dressed as described by Blasco et al. (1993). The dressed carcass is the portion of the rabbit remaining after the removal of the head, feet, skin (pelt), tail and visceral organs including kidneys. The dressed carcasses were split into retail cuts such as shoulder/forelegs, thigh/hindleg, rack and loin as described by Blasco et al. (1993). The dressed carcass and the retail cuts were weighed and expressed as percentage of slaughter weight.

Table 2. Proximate composition of experimental diets (on dry matter basis).

	Level of CBRCM in the diets (%)						
Nutrient (%)	**0**	**10**	**20**	**30**	**40**	**SEM**	**CBRCM**
Dry matter	92.11	91.23	92.01	92.31	92.30	1.03	91.63
Crude protein	19.20	19.01	18.94	18.63	18.24	0.48	36.40
Crude fibre	18.34^{b}	19.34^{ab}	20.12^{a}	20.31^{a}	20.43^{a}	0.54*	20.43
Ether extract	4.50^{a}	3.50^{b}	3.40^{b}	3.82^{b}	3.66^{b}	0.19*	4.01
Total Ash	2.00^{c}	3.01^{b}	3.08^{b}	3.07^{b}	3.55^{a}	0.03*	4.90
Nitrogen-free extract	48.07	46.37	46.47	46.48	46.42	0.45	25.89
ME(Kcal/kg)	3,061.48	2953.57	2,909.51	2,861.02	2,42.96	-	2,819.33

SEM = Standard error of means; NS= Not significant (P>0.05), *= Means in the same row bearing different superscripts differ significantly (P<0.05), - = Not determine, ME = Metabolizable energy calculated according to the formula of Pauzenga (1985): ME = 37x% CP+81x%EE+35.5% x NFE.

Table 3. Mean apparent nutrients digestibility of rabbits fed graded levels of camel blood-rumen content mixture (CBRCM).

	Level of CBRCM in the diets (%)					
Nutrients (%)	**0**	**10**	**20**	**30**	**40**	**SEM**
Dry matter	66.68^{a}	64.11^{ab}	62.45^{ab}	60.35^{b}	58.56^{b}	1.65*
Crude protein	78.32^{a}	75.33^{b}	73.03^{c}	71.85^{d}	70.53^{e}	0.23*
Crude fibre	38.54^{a}	37.43^{ab}	36.28^{b}	35.00^{c}	34.83^{c}	0.39*
Ether extract	70.56^{a}	67.73^{b}	65.87^{c}	65.17^{c}	53.60^{d}	0.39*
Total ash	63.77^{a}	56.07^{ab}	57.72^{b}	56.31^{ab}	54.17^{c}	1.21*
Nitrogen-free extract	80.16	86.27	84.46	75.89	75.98	3.83

SEM = Standard error of means; NS= Not significant (P>0.05), * = Means in the same row bearing different superscripts differ significantly (P<0.05).

$$\text{Dressing percentage} = \frac{\text{Dressed carcass Wt. (g)}}{\text{Slaughter weight (g)}} \times 100$$

Statistical analysis

All the data collected were subjected to analysis of variance (ANOVA) using the randomized complete block design (Steel and Torrie, 1980). Means were separated where applicable using the Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Proximate composition of the experimental diets

The proximate composition of the experimental diets and CBRCM are presented in Table 2. The dry matter (DM) and crude protein (CP) were similar (P>0.05) among the diets; these levels are adequate for growing rabbits as reported by Olumeyan et al. (1995), Mohammed et al. (2005a) and Dairo et al. (2005). Crude fibre (CF) in diets containing 20, 30 and 40% camel blood-rumen mixture (CBRCM) were higher compared to 0% CBRCM diet, but did not differ significantly (P>0.05) from 10% CBRCM diet. The crude fibre content increased linearly with increasing levels of camel blood-rumen content mixtures (CBRCM) in the diets. This was attributed to the fibrous nature of the CBRCM compared to groundnut cake and maize in the diets. The values obtained (18.24 to 19.20%) were within ranges (15 to 20%) reported to be adequate for weanling rabbits (Cheeke et al., 1982). The control diet (0% CBRCM) had higher level of ether extract (EE) than the CBRCM-based diets. However, the values in all the diets were within the recommended level (≥ 3%) for growing rabbits in the tropical countries as reported by Cheeke (1987). Diet containing 40% CBRCM had higher value while control diet had the lowest total ash (TA) content compared to CBRCM-based diets. Nitrogen–free extract (NFE) did not differ significantly (P>0.05) among the various diets. The metabolizable energy levels of the diets decreased linearly as the level of CBRCM increased in the diets. This was attributed to the higher energy content of groundnut cake and maize compared to CBRCM and the higher fibre level of the CBRCM. The values obtained in the study were similar to the values earlier reported by Mohammed et al. (2005a) and Dairo et al. (2005).

Nutrient digestibility

The apparent nutrient digestibility of rabbits fed graded levels of CBRCM is presented in Table 3. The digestibility of DM, CP, CF, EE and TA were significantly affected (P<0.05) by the test material in the diets. Rabbits fed

Table 4. Effect of varying levels of camel blood-rumen content mixture (CBRCM) on the body components and organs of rabbits expressed as percentage of slaughter weight.

Parameter	Level of CBRCM in the diets (%)					SEM
	0	10	20	30	40	
No. of rabbits slaughtered	3	3	3	3	3	-
Slaughter weight (g)	1320.8	1277.0	1348.3	1200.0	1173.2	71.08
Dressed weight (g)	696.50	637.75	628.75	646.50	635.25	46.57
Dressing percentage (%)	54.33	53.35	55.28	52.82	52.26	5.64
As % of slaughter weight						
Shoulder/forelegs	15.44^{a}	15.30^{ab}	15.46^{a}	13.79^{ab}	13.24^{b}	0.68*
Rack	5.73	6.64	5.46	5.14	5.46	0.58
Loin	10.66^{a}	8.51^{b}	10.05^{ab}	10.47^{a}	9.11^{ab}	0.57*
Thighs/Hind legs	22.15	20.01	20.70	19.40	19.41	0.44
Head	9.15	9.14	9.18	9.37	9.63	0.50
Tail	0.37	0.33	0.37	0.33	0.36	0.04
Skin	8.49	8.80	8.30	9.26	7.43	0.59
Feet	2.50	2.58	2.62	2.66	2.41	0.15
Heart	0.26	0.27	0.26	0.25	0.25	0.03
Liver	2.63^{b}	2.77^{a}	2.75^{a}	2.36^{b}	2.65^{b}	0.07*
Lungs	0.66	0.79	0.72	0.64	0.64	0.05
Kidneys	0.64	0.66	0.63	0.60	0.65	0.03
Caecum	5.49	5.67	5.26	5.04	5.50	046
Large intestine	2.22	2.53	2.48	2.65	2.58	0.61
Small intestine	3.79	3.56	3.80	3.74	3.69	0.40
Stomach	4.45	4.68	4.73	5.16	5.18	0.42
Body length (cm)	28.40	27.92	28.11	27.01	29.00	0.45

SEM = Standard error of means; NS= Not significant (P>0.05), * = Means in the same row bearing different superscripts differ significantly (P< 0.05).

control (0% CBRCM) had significantly (P<0.05) higher DM digestibility than those fed 30 and 40% CBRCM diets. There were no significant differences amongst the rabbits fed control, 10 and 20% CBRCM for DM digestibility. Apparent CP digestibility of the rabbits fed control (0%) was higher than those of rabbits on the CBRCM-based diets. The poorest CP digestibility was recorded in the rabbits fed 40% CBRCM. The values (70.53 to 78.52%) obtained here were higher than values (44.58 to 57.71 and 20.50 to 34.90) reported by Mohammed et al. (2005b) and Adeniji (2008).

Rabbits fed control (0% CBRCM) utilized the CF in their diets better (P<0.05) than those on the 20, 30 and 40% CBRCM diets. There were no significant differences amongst rabbits fed control and 10% CBRCM. The poorest CF digestibility was recorded in rabbits fed 30 and 40% CBRCM diets. Both nitrogen and CF utilization decreased linearly with increasing CBRCM in the diets. This may be attributed to poor utilization of the nutrient as a result of increasing fibre content of the diets. This is in agreement with the report of Adeniji (2008) that linked the low digestibility values for bovine rumen content to its high fibre content.

The rabbits fed control diet showed better EE digestibility than those fed test material in their diets. The poorest EE was recorded by the rabbits fed 40% CBRCM diet. EE digestibility tended to decrease with increasing levels of CBRCM in the diets. This may be attributed to fibrous nature of the CBRCM as earlier reported in Table 2. The decrease in the digestibility of EE with increasing levels of CBRCM in the diets, agree with the work of Igwebuike et al. (1998) who reported that increase in CF levels of the diets depressed EE digestibility. Rabbits fed 0% CBRCM showed better (P<0.05) TA absorption compared to those fed 20 and 40% CBRCM diets. Rabbits fed control did not differ from 10 and 30% CBRCM diets. The poorest TA absorption was recorded in rabbits fed 40% CBRCM diet. The NFE digestibility was not significantly affected by the test material in the diets and thus suggesting efficient utilization of soluble carbohydrates in all the diets. This was in line with the findings of Onifade and Tewe (1993) who reported high digestibility of readily available carbohydrates by rabbits in a feeding trial involving.

Carcass parameter

The carcass parameters presented in Table 4 showed that slaughter weight, dressed weight, dressing

percentage, rack, thighs, head, tail, skin, feet, heart, lungs, kidneys, caecum, large intestine, small intestine, stomach and body length were not significantly (P>0.05) different among the treatment groups. This is an indication that the organ developments of the growing rabbits were not compromised by the various levels of CBRCM included in their diets. The shoulder, loin and liver were significantly (P<0.05) different amongst the treatment groups. Rabbits fed control (0% CBRCM) diet had significantly (P<0.05) heavier shoulder than those fed 40% CBRCM diet. There were no significant (P>0.05) differences in shoulder amongst the rabbits fed the control, 10, 20 and 30% CBRCM diets. The weight of the shoulder is a reflection of the heavier slaughter weights of rabbits on these four diets. Rabbits fed control and 30% CBRCM diets had significantly (P<0.05) heavier weight of loin than those on 10% CBRCM diet. All other treatments were similar to the control (0% CBRCM). The liver weight were significant (P<0.05) higher in 10 and 20% CBRCM compared to other groups.

The carcass measurements of rabbits in this study compared favourably with the values reported by Mohammed (2010) who slaughter rabbits of similar weight and ages in the same environment. These also tallies with findings of Mohammed et al. (2005b) who fed goat rumen content to rabbits of similar ages.

Conclusion

From the result of this study, it can be concluded that inclusion of camel blood-rumen content mixture up to 40% level in the diets of growing rabbit will not adversely affect carcass measurement and digestibility of the growing rabbits. However, further studies are needed to evaluate blood parameters and histopathology for health status of rabbits which was not covered in this study.

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