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Nutrient Digestibility and Carcass Measurement of Growing Rabbits Fed Graded Levels of Bovine Blood-Rumen Content Mixture

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Abstract: A ten-week trial was conducted to assess the digestibility and carcass component of growing rabbits fed graded levels of Bovine Blood-rumen Content Mixtures (BBRCM). The BBRCM were included at 0, 10, 20, 30 and 40% levels in diets 1, 2, 3, 4 and 5, respectively. The BBRCM replaced maize and groundnut cake in the diets. Forty five cross bred rabbits (Dutch x New Zealand white) between 5 and 7 weeks of age were randomly allocated to the 5 dietary treatments in group of 9 and allowed unlimited access to feed and drinking water throughout the experimental period. The dry matter, ether extract and ash were similar ($P>0.05$) among the treatments while the crude protein, crude fibre and nitrogen-free extract were significantly ($P<0.05$) different among the treatments. The carcass component and organ weights expressed as percentage of slaughter weight were similar except dressing percentage, shoulder, loin, feet and small intestine which were significantly ($P<0.05$) different among the treatments. Therefore, diets containing up to 40% BBRCM could be tolerated by growing rabbits without adverse effect on their nutrient digestibility and carcass component.

Key words: Nutrient digestibility, carcass characteristics, rabbits and bovine blood-rumen content mixtures

INTRODUCTION

To increase protein supplies, a lot of strategies have been suggested which include the production of highly prolific animals such as poultry, pigs and rabbits (Joseph *et al*., 1996). However, pigs and poultry have the disadvantage of competing directly with man for scarce food, while rabbits can be raised on high fibre feed not utilized by man (Igwebuike, 1995). In addition, rabbits suffer from few devastating diseases unlike poultry where the whole flock can be wiped out within short period of time.

The ability of rabbits to thrive on diverse plant materials is quite useful especially now that studies on the utilization of non-conventional feeds are on the increase because of the necessity to cut feed cost and to conserve grains for human feeding in developing countries (Alawa and Umunna, 1993). However, one major limitation to the use of non-conventional feeds is inadequate information on their nutrient composition and feeding values. This paucity of information has led to varying abuses regarding the nutrition of rabbits due to the apparent satisfactory performance of rabbits fed unconventional feeds (Ikurior and Kayode, 1995). Therefore, to expand the horizon and information on the use of hitherto neglected feedstuffs, this study will be geared towards evaluating bovine blood-rumen content mixtures as potential feedstuffs for rabbits.

Bovine Blood-rumen Content Mixture (BBRCM) is a new innovation in animal nutrition. BBRCM had been classified as a protein supplement which is produced on daily basis, since slaughtering takes place everyday in the abattoirs and slaughter houses. The feedstuff can be processed in any part of the country and used for feeding livestock as reported by Adeniji and Balogun (2001). The potential of rumen content and blood-rumen content mixtures as feed for rabbits has been recognised by some workers (Mohammed *et al*., 2005a and Dairo *et al*., 2005). Since rumen content can be obtained at little or no cost, its incorporation into rabbits diets will go a long way in reducing the feed cost and hence cost of production. Similarly, it is envisaged that the widespread use of rumen content for animal feeding will enhance the disposal of this waste from the abattoir and slaughter houses.

The objective of this paper is to evaluate the nutrient digestibility and carcass measurement of growing rabbits fed diet containing up to 40% bovine blood-rumen content mixture (BBRCM) diets.

MATERIALS AND METHODS

Experimental animals and management: A total of-forty five Dutch x New Zealand white rabbits, age between five and seven weeks were used for the feeding trial which lasted for 10 weeks. Before the commencement of the experiment, a one-week adjustment period was observed. 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

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Table 1: Ingredients composition of the experimental diets

	Level of BBRCM in the diets (%)				
Ingredients (%)	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
BBRCM	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 Calculated Analysis	100.00	100.00	100.00	100.00	100.00
Dry matter (%)	89.34	90.21	88.97	90.10	90.02
Crude protein (%)	18.61	18.31	18.27	18.11	18.06
Crude fibre (%)	13.21	14.67	15.79	16.88	17.57
Ash (%)	3.23	3.39	4.52	4.42	4.61
Metabolizable Energy (Kcal/Kg)	2567.67	2566.26	2469.73	2454.76	2443.12

* 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. BBRCM: Bovine blood-rumen content mixture.

groups were randomly assigned to five dietary treatments. Each rabbit was individually housed in a wire cage measuring 38 x 33 x 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.

Experimental diets: The ingredient composition and the calculated analysis of the experimental diets are shown in Table 1. The bovine blood-rumen content mixtures 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 18% Crude Protein (CP) and 2800 K/cal of ME on dry matter basis.

Digestibility study: The nutrient digestibility study was conducted at the end of the last week of the experiment. Faecal samples were collected from three rabbits per treatment (i.e., 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 hours 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 (1980).

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 hours as recommended by Joseph *et al.* (1994) but drinking water was provided. Withholding feed for 12 hours 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.

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

Statistical analysis: All the data collected were subjected to analysis of variance (ANOVA) using the randomized complete block design (Stell and Torrie, 1980). Means were separated where applicable using the Duncan's multiple range test (Duncan, 1955). A computer package (Statistix 9.0) was used for the analysis.

RESULTS AND DISCUSSION

Proximate composition of the experimental diets: The proximate composition of the experimental diets is presented in Table 2. The dry matter and crude protein

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

	Level of BBRCM (%)					
Nutrients (%)	0	10	20	30	40	SEM
Dry matter (DM)	91.10	91.10	90.70	91.80	90.82	0.85^{NS}
Crude protein (CP)	19.20	18.74	18.84	17.70	18.83	0.76^{NS}
Crude fibre (CF)	18.34^{b}	20.12^{ab}	20.50^{a}	21.13^{a}	22.00^{a}	0.59*
Ether extract (EE)	4.50^{a}	2.50^{b}	2.00^{b}	2.50^{b}	2.50^{b}	0.23*
Total ash	2.00^{c}	4.00^{b}	4.00^{b}	4.50^{a}	4.50^{a}	0.15*
Nitrogen-free extract (NFE)	47.06	45.74	45.36	45.97	42.99	0.89^{NS}
ME (Kcal/kg)	3061.48	2800.10	2728.51	2815.94	2751.25	-

SEM: Standard error of mean; NS: Not significant (P>0.05); *: Significant (P< 0.05).
^{a,b,c}means in the same row bearing different superscripts differ significantly (P<0.05), - : Not determine; ME: Metabolizable energy; calculate according to the formula of Pauzenga (1985) as: ME (Kcal/kg) = 37 x %CP + 81x %EE + 35.5 x%NFE. BBRCM; Bovine blood-rumen content mixture.

Table 3: Mean apparent nutrient digestibility by rabbits fed graded levels of Bovine Blood-Rumen Content Mixture (BBRCM)

	Level of BBRCM (%) in the diets					
Nutrients (%)	0	10	20	30	40	SEM
Dry matter (DM)	55.32	51.85	53.33	54.93	57.10	2.81^{NS}
Crude protein (CP)	64.40^{a}	53.91^{ab}	61.13^{ab}	50.73^{bc}	56.73^{ab}	3.88*
Crude fibre (CF)	46.85^{ab}	39.42^{b}	53.57^{a}	54.88^{a}	55.16^{a}	3.58.*
Ether extract (EE)	76.50	77.30	78.75	80.71	80.35	2.89^{NS}
Ash	62.47	61.41	56.13	70.93	65.93	5.02^{NS}
Nitrogen-free extract (NFE)	79.30^{a}	73.33^{c}	79.12^{ab}	76.50^{b}	67.53^{d}	0.82*

SEM: Standard error of mean, NS: Not significant (P>0.05). *Significant (P<0.05).
^{a,b,c,d}Means in the same row bearing different superscripts differ significant (P<0.05).

did not differ significantly (P>0.05) among the diets. These diets contained adequate protein levels for growing rabbits as reported by Mohammed *et al.* (2005a) who fed goat rumen content to growing rabbits. The diets containing 20, 30 and 40% Bovine Blood-rumen Content Mixtures (BBRCM) had higher (P<0.05) crude fibre compared to 0% BBRCM diet, although 10% did not significantly differ (P>0.05) from 0% BBRCM diet. The Crude Fibre (CF) of the diets increased with increasing level of Bovine Blood-rumen Content Mixtures (BBRCM) in the diets. This was attributed to the higher fibre content of the BBRCM compared to Groundnut Cake (GNC) and maize. The fibre levels of the diets fall within the recommended ranges of 15.0 to 20% by Cheeke *et al.* (1982) for growing rabbits in the tropical region.

The control diet (0% BBRCM) had higher (P<0.05) fat content than the diets containing BBRCM. However, the fat content of BBRCM-based diets was close to the minimum requirement of 3% reported as the ideal level for rabbits (Cheeke, 1987). The diets containing 30 and 40% BBRCM had higher (P<0.05) ash content compared to 0, 10 and 20% BBRCM diets. However, 0% BBRCM diets recorded lower value. Nitrogen-free extract on the other hand, did not differ significantly (P>0.05) among the diets. Control diet had higher numerically metabolizable energy compared to BBRCM-based, because the quantity of maize and GNC were reduced with the inclusion of BBRCM; since maize and GNC have higher ME than the BBRCM.

Nutrient digestibility: The apparent nutrient digestibility of the rabbits is presented in Table 3. The dry matter, ether extract and ash digestibilities were not significantly (P>0.05) different among the treatment groups. The similarity in the digestibility of the fat and ash in the diets conforms to the common observation that animals fed on diets with proper energy and mineral balance seldom vary in their total mineral (ash) and fat digestibility (Underwood, 1980).

The crude protein, crude fibre and nitrogen-free extract were significantly (P<0.05) affected by the Bovine Blood-rumen Content Mixtures (BBRCM). Rabbits fed the control diet (0% BBRCM) digested the feed protein better (P<0.05) than those on the 30% BBRCM. There were no significant (P>0.05) differences amongst rabbits fed the control, 10, 20 and 40% BBRCM. Rabbits fed 20, 30 and 40% BBRCM utilized fibre better than those fed 10% BBRCM diet. This was attributed to the presence of bacteria in caecum that act on the fibre material effectively. Results here were comparable to the values (43.27-51.71%) reported by Mohammed *et al.* (2005b) who fed goat rumen content to growing rabbits. Rabbits fed control diet had significantly (P<0.05) higher NFE digestibility than the 10, 30 and 40% BBRCM diets. This implies that rabbits fed control and 20% BBRCM diets efficiently utilization of soluble carbohydrate (NFE) than rabbits on other diets. There were no significant (P>0.05) differences amongst rabbits fed control (0% BBRCM) and 20% BBRCM diets. The values (88.31-91.21%) reported by Ajaji *et al.* (2007) who fed blood-

Table 4: Effect of varying levels of Bovine Blood-rumen Content Mixture (BBRCM) on body components and organs of rabbits expressed as percentage of slaughter weight

	Inclusion levels of BBRCM (%)					
Parameters	0	10	20	30	40	SEM
No. of rabbits slaughtered	3	3	3	3	3	-
Slaughter weight (g)	1123.0	1061.0	1161.0	993.0	948.0	24.0^{NS}
Dressed weight (g)	549.0	502.60	555.2	492.0	445.0	0.82^{NS}
Dressing percentage (%)	49.81^{a}	48.00^{b}	45.88^{c}	50.46^{a}	45.93^{c}	0.51*
As % of slaughter weight						
Shoulder/fore legs	16.62^{abc}	17.33^{a}	15.31^{bc}	16.50^{ab}	14.93^{c}	0.44*
Rack	6.32	5.57	5.17	6.06	6.27	0.52^{NS}
Loin	11.25^{ab}	12.37^{a}	10.75^{ab}	9.95^{b}	9.38^{b}	0.71*
Thighs/hind legs	19.11	18.88	17.81	18.91	18.39	0.59^{NS}
Tail	0.30	0.37	0.40	0.44	0.38	0.08^{NS}
Head	8.72	8.85	9.23	9.53	8.75	0.26^{NS}
Skin	7.22	6.64	6.79	6.69	7.07	0.33^{NS}
Feet	2.50^{ab}	2.25^{b}	2.74^{ab}	2.94^{a}	2.55^{ab}	0.26*
Heart	0.21	0.22	0.23	0.21	0.21	7.60^{NS}
Liver	2.40	2.29	2.33	2.19	2.37	0.16^{NS}
Lungs	0.48	0.53	0.58	0.58	0.60	0.06^{NS}
Kidneys	0.50	0.52	0.62	0.53	0.54	0.05^{NS}
Caecum	0.73	0.82	0.82	0.74	0.79	0.04^{NS}
Large intestine	3.32	3.66	3.46	3.52	3.26	0.16^{NS}
Small intestine	4.03^{a}	3.75^{ab}	3.40^{b}	3.64^{ab}	3.78^{ab}	0.14*
Body length (cm)	27.5	28.12	26.14	27.01	26.01	0.48^{NS}

SEM: Standard error of means, NS: Not significant (P>0.05). *Significant(P<0.05).

^{a,b,c}Means in the same row bearing different superscripts differ significantly (P<0.05), -: Not analyzed.

wild sunflower leaf meal mixture to growing rabbits were similar to values recorded in this study.

Carcass parameters: The results of the carcass characteristics of the rabbits are presented in Table 4. The slaughter weights, dressed weights, rack, thighs, tail, head, skin, heart, liver, lungs, kidneys, caecum, large intestine and body length were not significantly (P>0.05) different amongst treatment groups. The values recorded were similar to those reported by Igwebuike *et al*. (1995) and Mohammed *et al*. (2005b). The results indicated that BBRCM diets can support growth of the rabbits. The dressing percentage, shoulder, loin, feet and small intestine were affected (P<0.05) by the inclusion of BBRCM in the diets. Rabbits fed control and 30% BBRCM diets had significant (P<0.05) higher dressing percentage than those on 10, 20 and 40% BBRCM diets. The lowest dressing percentages were obtained in rabbits fed 20 and 40% BBRCM diets. The values (45.93-50.46%) obtained were close to those reported by other workers who slaughtered rabbits of similar weight and age (Abu and Ekpenyong, 1993). The shoulders were heavier in rabbits fed diet 2 (10% BBRCM) than those fed 20 and 30% BBRCM diets. There were no significant (P>0.05) differences between rabbits fed 0, 10 and 30% BBRCM diets. The loin of rabbits fed 10% BBRCM was significantly (P<0.05) higher than those fed 30 and 40% BBRCM diets. There were no significant (P>0.05) differences in loin weights of rabbits fed 0% and the rest of the BBRCM-based diets. Rabbits fed control diet (0% BBRCM) had significantly (P<0.05) heavier weight of small intestine than those fed 20% BBRCM diet.

There were no significant (P>0.05) differences amongst rabbits fed control, 10, 30 and 40% BBRCM diets while the lowest value was recorded in 20% BBRCM diet for small intestine. All other parameter presented in Table 4 was not significantly affected by the various treatments administered to the rabbits.

Conclusion: The results obtained from the experiment indicated that: Bovine blood-rumen content mixtures (BBRCM) could serve as a useful feed ingredient for rabbits throughout the year. BBRCM could serve as substitutes for groundnut cake and maize in rabbits diets up to 40% without effect on nutrient digestibility and carcass measurements. However, further studies are needed to evaluate different methods of drying/processing bovine blood-rumen content mixtures and examine the different micro-organism that are present in the bovine blood-rumen content mixtures since this aspect was not covered in this study.

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