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Nutrient Digestibility, Haematological Indices and Carcass Measurements of Rabbits Fed Graded Levels of Goat Rumen Content

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ABSTRACT

A ten-week trial was conducted to assess the digestibility, carcass components and blood parameters of growing rabbits fed graded levels of goat rumen content (GRC). The GRC were included at 0,10,20,30 and 40% levels in diet 1,2,3,4 and 5 respectively. The GRC replaced maize and groundnut cake in the diets. Thirty 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 6 and allowed unlimited access to feed and drinking water throughout the experimental period. The crude protein, crude fibre, ether extract and ash digestibility were similar ($p>0.05$) among all the treatments. The carcass components and organ weights expressed as percentage of slaughter weight were also similar in all the treatments. The packed cell volume (PCV) haemoglobin concentration (Hb), red blood cell (RBC) count, white blood cell (WBC) count, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) did not differ significantly ($p>0.05$) among the treatments. Therefore diets containing up to 40% of GRC could be tolerated by growing rabbits without adverse effect on their nutrient digestibility, carcass components and blood parameters.

KEY WORDS: Nutrient digestibility; carcass data; Blood parameters; Rabbits; Goat Rumen content.

INTRODUCTION

The problems of low animal protein intake is wide-spread in many developing countries of the world. FAO (1987) reported that the average supply of protein to a Nigerian was 54 g per day out of which 6.8 g was of animal origin. Ebenebe (2000) noted that this arose from the shortfall in the supply of meat in the country to meet the demand of the ever-growing population.

There is therefore need to increase meat production to provide adequate animal protein at an affordable cost. One of the measures advocated is the intensification of highly prolific animals like poultry, pig and rabbits (Cheeke *et al.*, 1982). There is evidence that rabbits are beginning to make a useful contribution to meat supply in many developing countries which experience national animal protein shortage (Owen, 1981).

The most important and expensive feed items in monogastric and pseudo-ruminant diets are the protein and energy concentrate. The high cost of grain, especially maize, is brought about by the declining production and competition for its use by man, industries and livestock. Therefore the need to look for cheaper alternatives is paramount in ensuring sustained production of monogastrics. Earlier on, Cheeke (1986) noted that further research on nutritional content of the non-conventional feedstuffs are essential to develop efficient feeding systems for rabbits in tropical and sub-tropical agricultural systems.

One of such potential by-products is rumen content. Rumen content is usually abundant throughout the year within Nigerian abattoirs and slaughter houses. The potentiality of rumen content as feed for rabbit has been recognized by some workers (Egege, 1994 Ibeawuchi and Gbue, 1995; Olumeyan *et al.*, 1995; Gambo *et al.*, 2004). The study reported here, which is a follow up to a previous one by Gambo *et al.* (2004), examined the digestibility of nutrients, carcass measurements and haematological indices of growing rabbits fed graded levels of goat rumen content (GRC).

MATERIALS AND METHODS

Management of the experimental stock

Thirty (30) crossbred rabbits (Dutch x New Zealand white) of mixed sexes with age ranging from 5 - 7 weeks, were randomly allocated to five treatments in groups of 6 rabbits each. The housing, feeding and routine management of the rabbits were similar to the procedures described by Gambo *et al.* (2004).

Experimental diets

The composition of the experimental diets and goat rumen content (GRC) are shown in Table 1. The diet contained 0,10,20,30 and 40% of goat rumen content (GRC) in diets 1 (control), 2,3,4 and 5 respectively. The diets supplied approximately 21% crude protein.

Digestibility trial

The nutrient digestibility trial was conducted at the end of week 6 of the experiment. Three rabbits were randomly selected from each treatment for total collection of faeces. The rabbits were placed in individual cages and allowed three days adjustment period which was followed by five days faecal collection. The amount of faeces voided daily was weighed and

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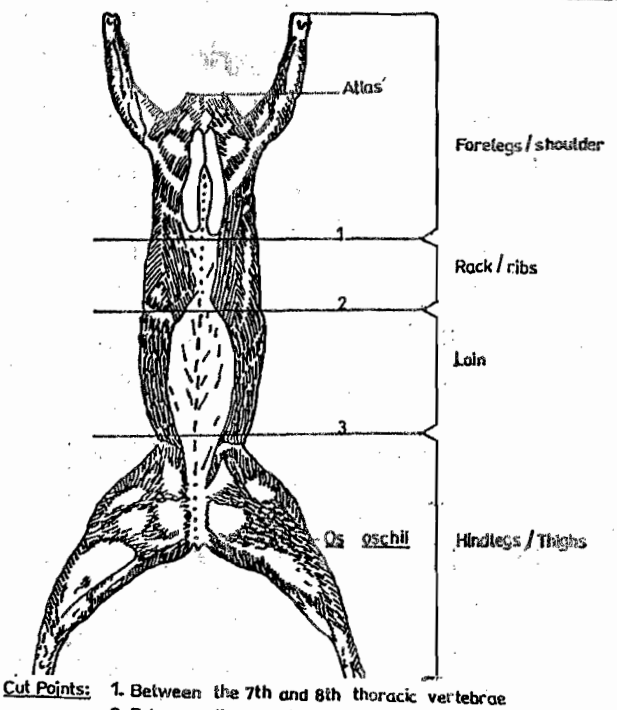
allowed to air - dry at room temperature for 2 - 3 days before reweighing again. Later the air - dried faeces were oven-dried at a temperature of 100°C for 24 hours until dry matter weight was obtained. Dried samples were bulked, ground and stored in air - tight containers for laboratory analysis. Samples of the diets and faeces were analyzed for nutrient composition by AOAC (1980) procedures.

Carcass measurements

At the end of the 10 - week (70 days) experimental period, three (3) rabbits were selected from each treatment based on the average live weight for the group. These rabbits were weighed and then starved overnight (12hours) but water provided. Their fasting weight was recorded in the morning before slaughter.

The rabbits were slaughtered in the morning dressed and weighed individually. The body components (head, tail, feet) and visceral organs such as lungs, liver, kidneys and heart were excised and weighed in the laboratory. The dressed carcass were split into retail cuts such as a shoulder/fore legs, thigh/hindlegs, rack and loin as described by Blasco et al. (1993). (see figure 1).



Cut Points: 1. Between the 7th and 8th thoracic vertebrae
2. Between the last thoracic and the 1st lumbar vertebrae
3. Between the 6th and the 7th lumbar vertebrae

Figure 1: Carcass division into retail cuts.
Source: Blasco et al (1993)

TABLE 1: COMPOSITION OF THE EXPERIMENTAL DIETS

Ingredient (%)	Diets				
	1	2	3	4	5
Maize	40.98	36.35	32.48	28.25	23.98
Maize offal	17.00	17.00	17.00	17.00	17.00
Goat rumen content	0.00	10.00	20.00	30.00	40.00
Groundnut haulms	13.00	13.00	13.00	13.00	13.00
Groundnut cake	23.37	17.60	11.87	6.10	0.37
Fish meal	3.00	3.00	3.00	3.00	3.00
Bone meal	2.00	2.00	2.00	2.00	2.00
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

Chemical Composition (%)

Nutrient (%)[1]	Treatments / Diets					
	1	2	3	4	5	Goat rumen content
Dry matter (DM)	99.97	99.98	99.97	99.97	99.98	99.97
Crude protein (CP)	21.11	20.69	20.89	20.93	20.51	27.25
Crude fibre (CF)	18.5	20.5	21.25	23.5	24.5	28.33
Ether extract (EE)	5.5	3.5	4.0	5.0	5.0	4.33
Ash	6.5	10.5	11.0	14.0	15.0	11.50
Nitrogen-free extract (NFE)	48.39	44.81	42.86	36.57	34.99	28.59
Metabolizable Energy kcal/kg)[2]	2944.41	2639.79	2618.46	2477.65	2406.02	2373.93

1. Mean of 3 determinations
2. Calculated

* Composition of premix (Bio – Mix) Supplying following per kg diet: Vitamin A, 5,000,00 IU, vitamin D_3 800,000 IU, vitamin E 12,000mg; vitamin K 1,5000mg, vitamin B_1 1,000mg, vitamin B_2 2,000mg, vitamin B_6 1,5000mg; Niacin 12,000mg; Pantothenic acid 20.00mg Biotin 10.00mg; vitamin B_{12} 300.00mg; folic acid 150,000mg; choline chloride 60,000mg; manganese 10,000mg; iron 15,000mg; zinc 800.00mg; copper 400.00mg; iodine 80.00mg; cobalt 40mg; selenium 8,000mg.

TABLE 2: APPARENT DIGESTIBILITY OF NUTRIENTS IN RABBITS FED GRADED LEVELS OF GOAT RUMEN CONTENT (GRC)

	Treatments/ Diets					
Nutrient (%)	1	2	3	4	5	SEM
Dry matter	67.96	71.97	65.17	66.18	68.92	4.23^{NS}
Crude protein	57.55	52.78	49.21	49.91	44.58	4.02^{NS}
Crude fibre	51.71	44.74	47.08	49.19	43.27	4.45^{NS}
Ether extract	62.94	63.27	64.14	64.03	60.95	2.69^{NS}
Ash	49.22	53.02	52.43	57.25	59.49	3.48^{NS}
Nitrogen – free extract	58.56	51.65	64.57	52.95	56.48	3.32^{NS}

SEM = Standard error of means NS = Not significant ($p>0.05$)

TABLE 3: EFFECT OF VARYING LEVELS OF GOAT RUMEN CONTENT (GRC) ON BODY COMPONENTS AND ORGANS OF RABBITS EXPRESSED AS PERCENTAGE OF SLAUGHTER WEIGHT

	Treatments					
Parameters	1	2	3	4	5	
Level of GRC	0	10	20	30	40	SEM
No of rabbits	3	3	3	3	3	-
Slaughter weight(g)	1133.33	1050.0	1100.0	983.33	933.33	24.89^{NS}
Dressed weight (g)	558.33	506.67	558.33	475.0	441.67	30.9^{NS}
Dressing percentage (%)	49.22	48.24	50.72	48.37	47.25	1.98^{NS}
As% of dressed wt.						
Shoulder/ Forelegs	33.11	31.97	32.75	31.64	32.22	11.34^{NS}
Rack	9.62	9.20	9.06	10.55	10.59	0.62^{NS}
Loin	21.46	21.09	22.02	21.09	20.74	0.98^{NS}
Thighs/ Hindlegs	42.82	40.70	43.14	39.96	41.48	0.93^{NS}
As% of slaughter wt.						
Shoulder/ forelegs	16.24	15.42	16.62	15.32	15.22	0.62^{NS}
Rack	4.74	4.44	4.59	5.11	5.01	0.29^{NS}
Loin	10.59	10.16	11.56	10.21	9.82	0.67^{NS}
Thighs/ Hindlegs	20.58	19.65	21.18	19.31	19.64	0.83^{NS}
Organs weight as % slaughter wt.						
Head	10.21	10.01	8.87	9.37	9.79	0.49^{NS}
Skin	8.39	8.11	7.15	9.99	11.57	0.95^{NS}
Feet	2.62	3.39	2.52	3.13	3.36	0.34^{NS}
Heart	0.28	0.40	0.38	0.45	0.48	0.11^{NS}
Liver	2.95	3.85	2.95	3.13	2.10	0.33^{NS}
Lungs	0.66	0.64	0.74	0.71	0.89	0.06^{NS}
Kidneys	0.88	0.86	0.91	0.79	0.87	0.10^{NS}
Body length (cm)	28.5	27.5	28.17	28.17	26.33	0.49^{NS}

SEM = Standard error of Means; NS = Non significant ($p>0.05$)

Blood collection / Haematological indices

At week 10 of the experiment, blood samples were collected from three (3) rabbits per treatment for the determination of the haematologcial parameters. Samples were collected from the ear vein of the rabbits by venipuncture using disposable needle (21 - gauge needle) and syringes. The rabbits were fasted overnight (12hrs), and normally bled in the morning (7.00 - 8.00am) to avoid excessive bleeding. Fasting the rabbits was done to avoid the temporary elevation of many blood metabolites by feeding. The collection site was cleaned with alcohol, and zylene applied to dilate the veins. Sterile cotton wool was used to cover the punctured veins after collection. The blood was collected in bottle containing dipotassium salt of ethylene diamine- tetra acetic acid (EDTA - K^{2+}) which served as anticoagulant. The blood was properly mixed with EDTA by gently turning round the bottle to prevent

haemolysis of the blood cells.

The haematological analysis of blood samples were carried out at the Department of Veterinary Pathology, Faculty of Veterinary Medicine, University of Maiduguri, Nigeria, using the routinely available clinical methods as expounded by (Bush, 1975). The haematological indices determined were packed cell volume (PCV), haemoglobin concentration (Hb), red blood cell (RBC) count or erythrocytes and white blood cell (WBC) count or leucocytes. Others such as mean corpuscular haemoglobin (MCH), mean corpuscular volume (MCV) and mean corpuscular haemoglobin concentration (MCHC) were obtained by calculation according to standard formulae (Schalm et al., 1975 and Jain, 1986) as shown below:

$$MCV = \frac{PCV \times 10}{RBC \text{ count (in } 10^6/mm^3)}$$

$$MCH = \frac{Hb\ (g/dl) \times 10}{RBC\ (in\ 10^6/mm^3)}$$

$$MCHC = \frac{Hb\ (g/dl) \times 100}{PCV\ \%}$$

Statistical analysis

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

RESULTS AND DISCUSSION

Nutrient digestibility

The digestibility of nutrient by the rabbits fed graded levels of goat rumen content (GRC) are shown in Table 2: Digestibility of dry matter was similar in all the treatments. Crude protein, crude fibre, ether extract and ash digestibility were also similar among the treatments. These may be due to similarity in the composition of the experimental diets especially the protein levels. The findings of this experimental indicate that inclusion of up to 40% level of goat rumen content has no adverse effect on the digestibility of nutrients by the rabbits on the various diets. This tallies with the similarity ($p>0.05$) in the weight gain, feed intake and feed conversion ratio of the rabbits on the various diets. Values obtained in this experiment compared favourably with those reported by other workers (Egege, 1994; Ibeawuchi and Gbue, 1995) who fed bovine rumen content to growing rabbits.

Carcass components

The weight of the experimental rabbit before and after slaughter and the carcass and organ measurements (expressed as percentage of slaughter weights) are presented in Table 3. Weight of the rabbits before and after slaughter showed no significant difference ($p>0.05$) among the treatments. The dressing percentages were also similar among the treatments. The values obtained were close to those reported by Abu and Ekpenyong (1993) and Igwebuike *et al.* (2002) who slaughtered rabbits of comparable weights and ages.

Shoulder, racks, loins and thighs were not significantly ($p>0.05$) different. The rack were between 9.0 - 11.0% of the dressed carcass while the shoulders, loins and hindlegs constitute about 89.0 to 91.0% (Table 3). This is in line with the functions performed by these sections. The racks contain a lot of skeletal structures which offer protection to vital organs such as the heart, liver and lungs. The shoulder, loins and hindlegs, on the other hand, are endowed with muscles which provide support and carriage and aid the animals in movement (Heath *et al.*, 1985). The organs and body components measured (Head, skin, feet, heart, liver, lungs and kidneys) were not significantly different ($p>0.05$).

TABLE 4: HAEMATOLOGICAL INDICES IN RABBIT FED DIETS CONTAINING VARIOUS LEVELS OF GOAT RUMEN CONTENT

Goat rumen content (%)	Treatments						
	0	10	20	30	40	Mean	SEM
Indices	1	2	3	4	5		
PCV (%)	36.0	32.33	37.33	35.67	36.3	35.33	3.64^{NS}
Hb (g/100ml)	11.47	11.87	11.67	11.47	10.0	11.30	0.70^{NS}
RBC (x $10^6/mm^3$)	7.93	8.42	7.97	7.91	9.26	8.30	0.90^{NS}
WBC (x $10^3/mm^3$)	4.27	4.47	6.27	5.33	4.60	4.99	4.2^{NS}
MCV (fl)	46.55	38.38	49.88	48.20	39.59	44.52	7.54^{NS}
MCH (pg)	14.74	14.26	15.68	15.16	10.88	14.14	2.20^{NS}
MCHC (%)	32.5	37.41	31.48	32.17	27.59	32.23	2.44^{NS}

NS = Not significant ($p>0.05$)
SEM = Standard error of means

PCV - Packed cell volume
Hb - Haemoglobin concentration
RBC - Red blood cell counts
WBC - White blood cell counts
MCV - Mean corpuscular volume
MCH-Mean corpuscular haemoglobin
MCHC - Mean corpuscular haemoglobin concentration

Equally the pelt (skin) and body length were similar in all the treatments. Values reported are similar to those reported by other workers (Rao *et al.*, 1978, Igwebuike *et al.*, 1995; Igwebuike *et al.*, 2002) for growing rabbits.

Haematological and erythrocytic indices

The haematological and erythrocytic indices are shown in Table 4. These include packed cell volume (PCV), haemoglobin concentration (Hb), red blood cell (RBC) counts and white blood cell (WBC) counts. Others are mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC).

The PCV (32.33 - 37.33%), Hb (10.0 - 11.37g/dl), RBC (7.91 - 926 x 10^6/mm^3) and WBC (4.27 - 6.27 x 10^3/mm^3) did not differ significantly ($p>0.05$) among the treatments. The MCV, MCH and MCHC were similar ($p>0.05$) in all treatments. These values fall within the normal range for healthy growing rabbits as reported by Anon. (1980). The normal PCV and other haematological values portray the nutritional status of the rabbits and indicate adequate nourishment of the subjects (Church *et al.*, 1984). Since no sign of anaemia or ill-health was observed in all the treatments the diets were nutritionally adequate. Hackbarth *et al.* (1983) reported that diets have very strong influence on haematological traits. Babatunde and Pond (1987) showed that performance trait and haematological traits are strongly correlated and this assertion is demonstrated in the present study. Therefore, up to 40% inclusion of goat rumen content into rabbit diet was adequately tolerated by growing rabbits in this experiment.

CONCLUSION

The results of this study indicate that up to 40% goat rumen content (GRC) could be incorporated into the diets of growing rabbits without adverse effect on the digestibility, carcass components and blood parameters of the rabbits. However, further studies are needed to evaluate different methods of drying/processing rumen content and examine the different micro-organisms that are present in the rumen content since this aspect was not covered in this study.

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