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Dried rumen waste as feedstuff for growing rabbits

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Abstract

This study was carried out to evaluate the growth performance, carcass chaaracteristics and haematological parameters of growing rabbits fed diets containing graded levels of Dried Rumen Waste (DRW) as a replacement for maize. A total of 48 weaner rabbits (mixed breed, average weight, 471 + 0.2 g) were randomly allocated to four dietary treatments comprising graded levels of 0, 10, 20, and 30 % DRW in the diets. Diet 1 (0% DRW) served as the control diet. Each of the four treatments was replicated thrice. Each replicate had four rabbits in a Completely Randomized Design. Feed and water were supplied ad libitum throughout the study period. All the performance indicators (average daily gain, 14.77 – 15.87 g; feed conversion ratio, 3.71-4.06) remained similar (P>0.05) regardless of the inclusion levels of DRW in the diets except the average daily intake (56.94-64.38 g; P<0.05). Red blood cell counts (4.10-6.10 x g/100ml) increased (P>0.05) while mean corpuscular volume (76.00-90.24 fl) and mean corpuscular haemoglobin (24.51-30.00 pg) decreased (P>0.05) in response to the inclusion levels of DRW in the diets. All the serum indices measured were not significantly influenced (P>0.05) by the treatments. It was concluded that DRW could replace 30 % dietary maize in the diets of growing rabbits without compromising growth performance, and health status of growing rabbits.

Keywords: Rabbits; Rumen Waste; Performance; Haematology; Serum

1 Introduction

Developing countries are suffering from a shortage of animal feed ingredients, daily increase in price and competition for this feedstuff between humans and livestock. The shortage and increase in prices of feed ingredients has greatly reduced the rate of expansion of rabbit industry [1]. Shortage and volatility in price of feed ingredients motivated to search for alternative feed source to solve this problem. In recent years, researches have been geared towards the search for traditional and inexpensive sources of feedstuff for inclusion in livestock feed. One of such sources is from abattoir, where rumen contents are gotten.

Rumen content is substantial wastes generated daily at abattoirs [2]. It is a material from the rumen of ruminants which is the first stomach compartment of the ruminants. It is account for about 80% of the capacity of the adult ruminant stomach [3]. It is plant material at various stage of digestion rich in protein and other micro-flora such as fungi, protozoa and bacteria [4, 5]. It is an important source of energy and vitamins especially vit. (B) Complex. Rumen contents could provide a valuable source of nutrients when included in diets for various classes of livestock. Previous studies have generally indicated that dry rumen contents contained substantial amounts of crude protein and utilizable energy for ruminants [6, 7]. The crude protein range of 9-20% had been reported for rumen content [5, 8]. The proximate compositions of rumen content were 92.83% dry matter; 17.13% crude protein; 7.49% ash; 2.81% ether extract; 24.58% crude fibre; 40.82% nitrogen free extract and 2278.50 Kcal/kg ME [9].

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Despite these qualities, the nutritional potentials of rumen contents in rabbit feed remain currently under-researched in Nigeria. Its utilization as animal feed will alleviate and maximize the economic environmentally benign disposal of slaughter house by- products [4, 10]. The present study was designed to determine the effects of feeding different levels of Dried Rumen Waste on the growth performance, and blood profiles of growing rabbits.

2 Material and methods

2.1 Experimental site

The research was carried out at the Rabbitry unit of the Teaching and Research Farm of the Department of Animal Science, Federal University, Gashua, Yobe State, Nigeria. It has an area of 772km^2 and Coordinates: 12°52′5″N 11°2′47″E. The hottest months are March and April with temperature ranges of 38-40^{o}C. In the rainy season, June - September, temperatures fall to 23-28 ^{o}C, with rainfall of 500 to 1000 mm [11].

2.2 Management of Experimental animals

A total of 48 weaner rabbits of composite breeds and mixed sexes, aged between 5 and 6 weeks were procured from a reliable rabbit farm in Portiskum, Yobe State, Nigeria. They were randomly divided into five groups of twelve (12) rabbits per treatment. Within each treatment, there were 3 groups of 4 rabbits for triple repetition in a completely randomized design. The rabbits were housed according to treatments in a well ventilated room in hutches. The hutches were fitted with drinkers and feeders. The rabbits were pre-conditioned for two weeks, during which they were treated twice (once a week) against parasitic infestation with Ivermectin subcutaneously. They had access to feed and fresh water over 8 week experimental period.

2.3 Collection and Processing of camel rumen content

Rumen contents were collected from Maiduguri abattoir, Kasuwan Shanu, Borno State, Nigeria. After slaughtering the animals, the rumen was split open with aid of sharp butcher's knife and the contents emptied into a polythene bags. It was allowed to drain in the sack. After draining, the rumen contents were then spread on a cemented floor and allowed to sundry while turning was done between 3-4 hours interval until the moisture content was below 15% after 4 -5 days of sun drying. The dried rumen content was then ground and incorporated into the diets.

2.4 Experimental diets

Four experimental diets were formulated using the following ingredients: yellow maize, maize offal, bone meal, groundnut cake, fish meal, common salt, premixes and dried rumen waste as shown in Table 2. Dried rumen waste was included in the diets at 0, 10, 20, and 30% in Diets 1, 2, 3, and 4 respectively.

Table 1 Proximate Composition of Dried Rumen Waste

Nutrients (%)	Composition
Dry matter	92.54
Crude protein	21.35
Ash	6.86
Ether extract	3.57
Crude fibre	24.95
Nitrogen free extract	35.81
Metabolisable energy (Kcal/Kg ME)	2353.24

Metabolizable Energy ME (Kcal/kg) = 37 x % CP + 81.8 x % EE + 35.5 x %NFE [12].

Table 2 Gross Composition of Experimental Diets

	Control	**Levels of Dried Rumen Waste**		
Ingredients (%)	**0% DRW**	**10% DRW**	**20% DRW**	**30% DRW**
Yellow maize	42.70	37.70	35.00	32.00
*DRW	0.00	10.00	20.00	30.00
Maize offal	24.00	24.00	16.70	9.70
Rice offal	17.00	17.00	17.00	17.00
Soyabean meal	2.00	2.00	2.00	2.00
Fish meal	0.50	0.50	0.50	0.50
Groundnut cake	10.00	5.00	5.00	5.00
Limestone	1.00	1.00	1.00	1.00
Bonemeal	2.00	2.00	2.00	2.00
Salt	0.20	0.20	0.20	0.20
*Premix	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10
Total	100	100	100	100

Calculated Nutrients				
Crude protein (%)	16.98	16.84	16.65	16.29
Energy (Kcal/kg ME)	2689.50	2674.13	2654.63	2636.69
Crude fibre (%)	9.51	10.06	10.17	10.25
Ether extract (%)	4.18	4.14	4.16	4.19
Ca (%)	1.06	1.13	1.13	1.14
Avail. P	0.79	0.61	0.61	0.66

*DRW – Dried Rumen Waste. NFE= Nitrogen free extract. ME=Metabolizable energy. **Premix in diets provided per kg: Vit. A 10000 IU, Vit. B 2000 IU, Vit. E 13000 IU, Vit. K 1500mg, Vit. B12 10mg, Riboflavin 5000mg, Pyridoxine 1300mg, Thiamine 1300mg, Panthothenic acid 8000mg, Nicotinic acid 28000mg, Folic acid 500mg, Biotin 40mg, Copper 7000mg, Manganese 48000mg, Iron 58000mg, Zin c 58000mg, Selenium 120mg, Iodine 60mg, Cobalt 300mg, Choline 27500mg

2.5 Performance data

The amount of feed given and left over was recorded on daily basis and it was used to calculate the feed intake. Before the commencement of the experiment, the initial weights of the rabbits were taken and the rabbits were weighed weekly thereafter to obtain weekly weight gain. Feed intake and weight recorded were used to calculate feed conversion ratio (FCR) using the formula below:

Feed conversion ratio (FCR) =feed intake/weight gain

2.6 Blood collection

At the end of the study period, blood (5mL) was collected from six rabbits per treatment through the jugular vein of each slaughtered rabbit and put into bottles containing Ethylene Diaminetetra- acetic Acid (EDTA) for haematological analysis which include packed cell volume (PCV), haemoglobin concentration (Hb), red blood cell (RBC) count or erythrocytes and white blood cell (WBC) count or leucocytes and differential counts. 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 [13, 14] shown below:

$$\text{MCV} = \frac{\text{PCV x 10}}{\text{RBC count (g/100ml)}}$$

$$\text{MCH} = \frac{\text{Hb (g/dl) x 10}}{\text{RBC (g/100ml)}}$$

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

Similarly, blood samples meant for serum biochemical studies were collected into plain bottles (without anticoagulant) to enhance serum separation. Serum was obtained by centrifugation and the harvested serum samples were used for analysis. All the analysis was done at the Department of Haematology Laboratory, University of Maiduguri Teaching hospital, Borno State, Nigeria according to the methods described by [15].

2.7 Chemical analysis

Proximate composition of DRW and experimental diets were analysed using the methods described by [16].

2.8 Statistical analysis

Data collected were subjected to analysis of Variance using SAS software [17].while significant means were separated with Duncan multiple range test at 5% level of significance.

3 Results and discussion

The result of the proximate composition of the dried rumen waste used in this study is presented on Table 1. The result shows that DRW contained 21.35 % crude protein, 24.95 % crude fibre, 3.57 % ether extract, 6.86 % ash, 35.81 % NFE and 2353.24 Kcal/kg ME. This result differs from the report of [18] who observed that dried bovine rumen digesta contains 18.20 % moisture, 15.30 % crude fibre, 18.52 % crude protein, 7.60% ash, 8.79% ether extract and 38.39% NFE. [19] gave the following as the proximate composition of bovine rumen content: moisture 9.69%, crude fibre 39.95%, crude protein 9.82%, fat 1.10%, NFE 30.55% and Ash 18.58% while [7] reported that camel rumen content contained 23.70 % crude protein, 28.10 % crude fibre, 3.00 % ether extract, 12.00 % ash, 33.70 % NFE and 2316.25 Kcal/kg ME. Therefore, DRW provides a richer source of nutrients suitable of exploitation for use as possible feed ingredient.

The performance of growing rabbits fed diet containing dried rumen waste is presented in Table 3. All the performance indicators remained similar ($P>0.05$) regardless of the inclusion levels of DRW in the diets except the average daily intake ($P<0.05$). Various studies have been reported on the substitution of more expensive protein concentrates particularly animal by-product meals and rumen content which usually constitute a major source of dietary protein with less expensive and non-competitive feedstuffs in livestock production [20, 21]. The increase observed in the average daily feed intake as DRW levels increased in the diets may be attributed to the fibrous nature and low energy content of dried rumen waste in comparison with dietary maize. This implied that rabbits fed DRW diets would eat more feed in order to meet the energy requirement [6]. Similarities observed in average weight gain and feed conversion ratio indicated that rabbits would tolerate up to 30 % inclusion of DRW in the diet without adverse effect on growth parameters. Previous studies had earlier observed that inclusion of blood-rumen content mixture up to 40% level in the diets had not adversely affect performance, digestibility, blood parameters and carcass measurement of growing rabbits [22, 23]. Our result confirms the assertion of [24] that rumen content/ blood meal (50:50) mixture can be included in the diet of growing rabbits to replace 10% groundnut cake and palm kernel cake without compromising growth performance.

The results of haematological parameters and serum biochemical indices are shown on Table 4 and 5 respectively. Changes in haematological parameters are of value in assessing the responses of animals to various physiological and disease conditions [13, 25, 26]. Changes in haematological parameters are often used to determine stresses due to nutrition and other factors [27]. Reports also stated that PCV, Hb and MCH were major indices for evaluating circulating

erythrocytes and were very significant in the diagnosis of anemia and also served as useful indices of bone marrow capacity to produce red blood cells as in mammals [28].

Table 3 Growth Performance of growing Rabbits fed diet containing Dried Rumen Waste

Items	0%	10%	20%	30%	SEM
Mean initial body weight (g)	472.30	471.05	473.60	471.09	0.83
Mean final body weight (g)	1333.01	1300.01	1300.90	1360.02	20.08
Average daily gain (g)	15.36	14.80	14.77	15.87	0.36
Average daily feed intake (g)	56.94c	59.07b	59.21b	64.38a	1.08
Feed conversion ratio	3.71	3.99	4.01	4.06	0.17

SEM= Standard error of mean. [a,b]Means in the same row bearing different superscripts differ significantly (P<0.05).

Table 4 Haematological Indices of growing Rabbits fed diet containing Dried Rumen Waste

Parameters	0%	10%	20%	30%	SEM
Packed cell volume (%)	37.00	37.00	38.00	39.00	1.01
Haemoglobin (g/dl)	12.30	12.40	12.40	12.50	0.51
Red blood cell (g/100ml)	4.10[b]	4.50[b]	5.00[a]	5.10[a]	0.23
White blood cell (g/100ml)	3.40	3.30	4.80	6.30	0.47
MCV (fl)	90.24[a]	82.22[b]	76.00[c]	76.47[c]	1.57
MCH (pg)	30.00[a]	27.55[b]	24.80[c]	24.51[c]	0.76
MCHC (%)	33.24	33.51	32.63	32.05	0.27

[a,b]Means in the same row bearing different superscripts differ significantly (P<0.05). SEM= Standard error of mean. MCV= Mean corpuscular volume. MCH= Mean corpuscular haemoglobin. MCHC=Mean corpuscular haemoglobin concentration

Table 5 Serum biochemical Indices of growing Rabbits fed diet containing Dried Rumen Waste

Parameters	0%	10%	20%	30%	SEM
Albumin (g/dl)	3.17	3.19	3.50	3.69	0.95
Total protein (g/dl)	4.79	5.17	5.14	5.39	0.39
Glucose (mmol/l)	7.90	8.19	7.40	7.40	1.66
Cholesterol (mmol/l)	2.60	2.02	2.70	3.20	0.80
Calcium (mg/dl)	2.70	2.80	2.70	2.70	0.47
Phosphorus (mg/dl)	1.70	1.50	1.70	1.63	0.94
Blood urea (mmol/l)	5.70	4.42	4.53	4.73	1.34

SEM= Standard error of mean

Nutrition also has a strong influence on the hematological traits and values of these traits are indicators of nutritional status of the animals [29, 30]. [31] Also reported that hematological constituents reflect the responsiveness of the animal to its environments which includes feed and feeding. In this study, the values of RBC (4.10-6.10 x g/100ml) increased (P>0.05) while MCV (76.00-90.24 fl) and MCH (24.51-30.00 pg) decreased (P>0.05) in response to the inclusion levels of DRW in the diets. This implied that dried rumen waste had effect on the aforementioned parameters. The values however fall within the normal ranges earlier established for healthy rabbits [6, 32, 33, 34].

There were no significant differences (P>0.05) in all the serum indices measured. The dietary inclusion of DRW did not exert any adverse effect on the cholesterol (2.02-3.20 mmol/l), glucose (7.40-8.19 mmol/l), and urea (4.42-5.70 mmol/l) compositions of the rabbits fed the experimental diets. Cholesterol, a high molecular weight sterol is used in the body as raw material for the therapeutic process useful in the normal role of the brain and it is an essential constituent of the cell membrane including organelles inside the cell [30]. The values obtained for total protein (4.79-5.39 g/dl), and albumin (3.17 – 3.69 g/dl) were similar with the values earlier reported by [35] for growing rabbits fed diets containing various levels of Bovine blood rumen – content mixture. Also, [36] reported that albumin concentration in serum is predicated on factors that are independent of nutrition such as infections, liver function, kidney disease, trauma and hydration status which the result of this study clearly shows that none of these extra- nutritional factors had considerable effects on the rabbits. The normal serum values obtained in this study indicated nutritional adequacy of dietary protein. Abnormal serum albumin usually indicates an alteration of normal systematic protein utilization. [37] Reported the dependence of blood protein on the quality and quantity of dietary protein.

4 Conclusion

The findings from this study showed that dried rumen waste (DRW) has a high potential as feed ingredient and could be included in the diet of growing rabbits. It was concluded that DRW can replace 30 % dietary maize in the diets of growing rabbits without compromising growth performance, and health status of growing rabbits.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors hereby declare that there's no conflict of interest and that the paper should be published.

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