EFFECTS OF GRADED LEVELS OF SUN-DRIED CATTLE RUMEN DIGESTA ON GROWTH PERFORMANCE AND ECONOMICS OF PRODUCING GROWING RABBITS

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ABSTRACT

A twelve week feeding trial was carried out on thirty (30) growing rabbit bucks with initial body weights averaging 784.16 g to investigate the effect of sundried cattle rumen digesta (SCRD) on performance and economics of production. The animals were randomly distributed according to live weight into five (5) treatment groups with six animals each serving as replicate in a completely randomized design (CRD). The levels of sundried cattle rumen digesta in the diets were such that diet 1 (control) was without the test material while diets 2, 3, 4 and 5 had 5, 10, 15 and 20 % SCRD respectively. Feed and water were provided ad-lib. The result showed that dietary treatments had no significant effect (P>0.05)) on performance. With regards to economics of production, result showed that the cost per kg diet, cost of feeding and cost per kg weight gain decreased at inclusion of SCRD. It is concluded from these results that SCRD can be incorporated into rabbit diets up to 20% without any adverse effect on performance, and economics of production. More so, that rabbits can be raised using SCRD as alternative feedstuff to table size at lower cost.

KEYWORDS

Rumen digesta, rabbit, proximate composition, performance, feed cost analysis.

1. INTRODUCTION

The need to improve rabbit production in Nigeria to increase supplies of animal protein is clear, due to the high cost of chicken and beef. Also, the animal protein shortage facing Nigeria cannot be solved by large animals with their slow production cycle. Animals like rabbits, with very short gestation periods and production cycles, can help reduce this protein shortage challenges. Rabbits can be produced on forages alone, although production can improve by adding other feed supplements. The need to explore other less common, but potential sources of animal protein such as rabbits has been reported [1]. The advantages projected include the high reproductive rate, rapid maturity, high genetic potential, efficient feed utilization, limited competition with humans for food and high quality nutritious meat [2]. Rabbits have been introduced into West Africa as farm animals of economic value. They are low in fat, succulent, nicely flavored and provide a palatable change to chicken and other meats ([3], [4]). It is also reported that rabbit meat plays an important role in preventing vascular diseases due to its extremely low cholesterol and sodium levels [5]. This makes rabbit meat a good source of animal protein for coronary heart patients and people on low sodium diets. Rabbits can thrive on non-conventional feed stuffs and

forages ([6], [4]). They are being maintained solely on all forage diets with encouraging weight gains [7]. However, these investigators used temperate forages, which are known to have, on the average, higher crude protein and lower fibre contents, and has higher nutritive value than tropical forages [8]. Although, the rabbit requirement for crude fibre is very high of about 14-25 % when compared with other monogastrics, it has been reported that the feeding of concentrate increases feed consumption and crude fibre digestion ([9], [10]). Feed accounts for the dominant input in animal production, ranging from 60-70 % of the total cost of production [11]. Conventional feedstuffs are very expensive and scarce, the crippling realities that are characteristic of the economics of developing countries [12]. Conventional ingredients face stiff competition with channels in the food chain, which command a higher priority and can pay higher prices than the compound feed industry.

In an attempt to search for alternative sources of animal protein feedstuffs, there is an urgent need to explore the potentials of non-conventional protein sources that are not in competition with humans [5].

One such alternative feedstuff, which is not only cheap but also locally available, and does not attract competition in consumption between humans and livestock, is the bovine rumen digesta. The rumen is a unique organ. Its content (rumen content or digesta) is heterogenous. It is made up of digested feed at different stages of degradation, saliva (making up the rumen liquor) micro-organisms and the products of their metabolic activities such as proteins, peptides, amino acids, lipids, vitamins and Volatile Fatty Acids) [13]

The objective of this work therefore was to determine the effect of sundried cattle digesta on the growth performance and economics of producing growing rabbit bucks

2. MATERIALS AND METHODS

2.1. Study Area

The experiment was conducted at the Rabbitry Unit of the Livestock Teaching and Research Farm, College of Animal Science, Joseph Sarwuan Tarka University, Makurdi, Benue State, Nigeria. Makurdi is located between latitude $17^0$14' N and longitude $8^0$21' E in the Guinea Savanna zone of Nigeria. It has a tropical climate which is characterized by wet and dry seasons. It has an annual rainfall of 6-8 months (March - October) with rainfall ranging between 508 to 1016 mm and a minimum temperature range of 24.20 ± 1.4 ^{0}C and maximum temperature range of 36.33 ± 3.7 ^{0}C. The relative humidity ranges between 39.50 ± 2.20 % and 64.00 ± 4.80 % [14].

2.2. Experimental Animals, Design and Management

Thirty (30) male cross-bred growing rabbits of ages 5-7 weeks were sourced and procured from commercial rabbit farmers within Makurdi, and were randomly allocated and subjected to five dietary treatment groups of six rabbits in each treatment in a Complete Randomized Design (CRD). The rabbits were intensively managed, housed individually in hutches having cages and provided with drinkers and feeders which were firmly fixed in order to prevent tipping over. The cages were properly cleaned and disinfected with Izal and allowed to dry for one week after which test animals were introduced. Routine management such as cleaning of drinkers, feeders and the hutches was done. Before the commencement of the experiment, the animals were treated against internal and external parasites by subcutaneous injection of ivomectine (0.2ml per rabbit). Also, a broad spectrum antibiotic (oxytetracycline), coccidiostat and multivitamins in soluble powdered forms was administered orally in drinking water.

The test animals were conditioned for one week to facilitate adaptation and acclimatization. Within this period, the test animals were fed experimental diets (mash) and water *ad-libitum.* Prior to the commencement of the experiment, the animals were starved of feed for twelve (12) hours and weighed for their initial body weights. However, water was provided within this period.

2.3. Collection of Test Ingredients and Preparation

Fresh cattle rumen content was collected free of charge after slaughter from the Wurukum abattoir located in Makurdi Local Government area. The sample was sundried by thinly spreading it out on a flat surface and frequently turned to preserve the nutrients therein as much as possible. After drying to about 10 % moisture content to further avoid deterioration, it was packed and stored in bags until when needed. Other ingredients used in formulating the diets were bought from Wadata market

2.4. Formulation of Experimental Diets

Five (5) isocaloric and isonitrogenous experimental diets were formulated as shown in Table 1. Diet 1 served as the control diet without rumen content. Diets 2, 3, 4 and 5 had 5 %, 10 %, 15 % and 20 % sundried cattle rumen digesta, respectively. The experimental diets were fed in mash form.

2.5. Experimental Diets and Feeding

Five dietary treatments were coded T1, T2, T3 T4 and T5; 0, 5, 10, 15 and 20 %, respectively. A total of 50.4 kg of feed per treatment was compounded and fed to the experimental animals for a period of 84 days. Each animal was fed a daily allowance of 100 g of feed every morning with fresh, clean and cool water *ad libitum*. The left over feed was collected and weighed at the end of every week where actual feed intake was determined by difference. Performance indices such as body weight gain, feed conversion ratio (FCR) were obtained by calculation.

2.6. Data collection

Data was collected on feed intake, body weight gain, feed conversion ratio, mortality rate and were used in assessing the performance of the animals

2.7. Chemical Analysis

The chemical composition of experimental diets was determined using the procedure of AOAC [15]

2.8. Statistical Analysis

All data collected was subjected to one way analysis of variance (ANOVA) using MINITAB 16th version. Where significant differences occur, such means were separated using Fisher's Least Significant difference of the same statistical software.

Table 1: Ingredient and Nutrient Composition (%) of Experimental Diets

Ingredient	**T_1 (control)**	**T_2 (5%)**	**T_3 (10%)**	**T_4 (15%)**	**T_5 (20%)**
Maize	40.60	33.60	35.50	36.40	20.00
Maize offal	5.00	3.25	1.25	1.3	4.5
SCRD	0.00	5.00	10.00	15.00	20.00
Cassava	4.00	9.50	8.50	5.50	19.00
Rice offal	25.00	21.75	20.25	18.10	13.50
GNC	22.40	23.90	21.50	20.70	20.00
Bone meal	2.50	2.50	2.50	2.50	2.50
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated nutrient composition Crude protein	16.03	16.04	16.11	16.20	16.01
Crude fibre	11.88	11.82	12.09	12.38	12.37
ME (Kcal/kg)	2563.10	2563.44	2582.45	2590.16	2563.06

GNC= Groundnut cake, SCRC = Sundried cattle Rumen Content, ME (Kcal/kg) = [37 x %CP + 81 x %EE + 35.5 x %NFE + 35.5 x (0.22) CF] (Pauzenga, 1985; modified by Carew, 2016).
Premix (Agrimix Broiler starter) Manufactured by AGRITED Nigeria Ltd. To make available the following per kg of diet: vit.A-10,000 iu, vitD3. 3000 iu, E-30 iu, Vit k-0.0023g. Thiamine (B1)-0.0017g. Riboflavin (B2)-0.005g. Pyridoxin (B6)-0.0031g,Vit B12-0.016mg,Biotin-006mg,Niacin-0.031g, Pantothemic acid-0.008g,Folic acid-0.008g, Manganese-0.085g,Zinc-0.05g,Iron-0.025g,Copper-0.006g, Iodine-0.001g, Selenium-0.12mg, Cobal33t-0.22mg, B.H.T.-0.06g, Ethoxyquin-0.065g, Choline Chloride-0.02g.

3. RESULTS AND DISCUSSION

The result of proximate composition of sun dried cattle rumen digesta is presented in table 2. The Dry Matter (DM) of 90.8 % in this study is lower than 93.80 % reported by [13], 94.53 % reported by [16] and 96.32 % by [17] but similar to 89.1 % reported by [18]. This could be due to method of processing used. The Crude Protein value of 13.58 % recorded in this study is within the range of 9 – 20 % reported by [19] but differs from 17.13, 18.58 and 18.53 % reported by [13], [16] and [17] respectively. The variation in the crude protein may be due to the effect of age, season and diversity of vegetation. The ether extract (EE) value of 2.20 % reported in this study is similar to that reported by [17] who reported an EE value of 2.99 % and [18 who reported the EE of cattle rumen digesta to be 2.0 % but less than 3.77 % reported by [19]. In contrast to the reports of [20], [13], [17] and [18] who reported values of 15.42 %, 7.49 %, 14.23 % and 9.67 % respectively for ash content. The result of ash (18.35 %) in this present study is similar with the findings of [16] who reported 18.40 % as the ash content of cattle rumen content. The crude fiber value of 23.75 % reported in this study is similar to the value 24.58 % reported by [13] but does not agree with the values of 34.4 %, and 18.40 % by [16]and [19]. These differences could be due to the amount of lignification and cell wall thickness [21]. The NFE value of 32.72 % reported in this study for sundried cattle rumen content was lower than 40.82 % reported by [13], higher than 24.81 % reported by [19] but similar to the value of 35.97 % reported by [17].

Table 2: Proximate Composition of Sundried Cattle Rumen Digesta

Parameters	Composition (%)
Dry matter	90.78
Crude protein	13.58
Ether extract	2.20
Ash	18.53
Crude fibre	23.74
NFE	32.72

The result on the proximate composition of experimental diets is presented in Table 3. The result revealed crude protein, (CP) values of between 18.20 – 19.60 %. The CP values reported in this study were higher than those recommended by [22] and that reported by [4] for growing rabbits. These values are also higher than 14 – 17 % recommended by [23], 16 % recommended by [24] and 16 – 17 % by Halls [25]. These values however agree with those of [26] who stated that CP values of 18 – 22 % was optimum for rabbit production in the tropics. This is evident as can be seen in the weight gain of experimental animals. The variation in the protein requirements of rabbits may be due to the protein quality of the diets used and geographical location where the experiment was conducted. The crude fibre (CF) of 10.88 – 12.02 % in this study is higher than 6.61 – 10.01 % reported by [19] and low compared to 18.5 – 24.5 % reported by [27] but within the range of 10 – 17 % recommended by [28], [29], [30] reported that, although rabbits digest fiber poorly, dietary fiber is useful in preventing enteritis, fur chewing and level of 15 – 18 % dietary fiber is therefore suggested for optimum growth in rabbits. The ether extract (EE) value of 3.46 – 3.95 % observed in this study is higher than the recommended value of 2 % by [28], 3 % by [31], and 2.5 % recommendation by [25]. However, these values fell within the range of 3 – 6 % by [4] and 2 – 4 % recommended by [23]. Cattle rumen digesta is a low energy feedstuff, this may the reason for the reduction for the reduction in EE as inclusion levels increased. The ash content (11.45 – 14.98 %) in this study is higher than 5.16 – 5.61 % reported by [32], 5.00 – 6.81 by [33], 5 – 6.5 % reported by [4], and this difference could be due to the ash content contained in the test diets. ([31], [34]) stated that a metabolizable energy of 2120–2600 Kcal/kg was adequate for growth and productive performance. [35] reported ametabolizable energy of 2600–2700 Kcal/kg depending on the physiological state of the animal. The ME values of 2626.71–2790.82 Kcal/kg in this study is higher than that reported by [13], [34] but fell within that reported by [35]. The lower limit in this study was within the range of 2500-2700 Kcal/kg ME requirement of growing rabbits in accordance with [36], 2350 to 2060 Kcal/kg recommendation by [37] and [38] for growing rabbits.

The result of nutrient composition of experimental diets as analyzed is comparable with calculated nutrient composition. The difference in crude protein recorded in diet 2 compared to other experimental diets could be due to a slightly higher inclusion level of the main protein source of the diet. The disparities observed between calculated and analyzed nutrient composition of experimental diets can be attributed to errors during feed mixing and laboratory procedures. Fibre levels can be seen to be increasing as test ingredient increased. More so, the ME lowered as inclusion levels increased owing to the fact that SCRD is a high fiber ingredient.

Table 3: Proximate Composition of Experimental Diets (As Analyzed)

Nutrient (%)	**T1** (0% SCRD)	**T2** (5% SCRD)	**T3** (10% SCRD)	**T4** (15% SCRD)	**T5** (20% SCRD)
Dry Matter	92.97	93.85	93.81	92.91	93.14
Crude Protein	18.32	19.60	18.28	18.20	18.29
Ether Extract	3.71	3.81	3.95	3.85	3.46
Ash	11.45	12.54	12.23	12.62	14.98
Crude Fibre	10.88	10.53	11.04	11.49	12.02
NFE	48.61	47.37	48.31	46.75	44.39
Metabolizable Energy (Kcal/kg)	2790.82	2797.68	2789.43	2703.02	2626.71

ME (Kcal/kg) = [37 x %CP + 81 x % EE + 35.5 x % NFE + 35.5 x (0.22) CF] (Pauzenga, 1985; modified by Carew, 2016)

The effects of SCRD on growth performance is presented 4, there were no significant ($p>0.05$) differences in all the parameters measured. Growth performance indices in this study revealed no significant ($P>0.05$) effect of treatment on average daily feed intake, average daily weight gain and feed conversion ratio. The result of this study agrees with [27] who observed no significant difference in performance of growing rabbits fed graded levels of sundried goat rumen content. The result agrees with [39] and [40] who also observed no difference across treatments. The final weight of 1303.16 – 1423.66 g obtained in this study is similar to the results of [27], [41] in which graded levels of rumen content were incorporated in diets of young rabbits but higher than 577.50 – 1100 g reported by [5] and also higher than 1004 - 1120 g reported by [42]. The average daily feed intake values of 45.62 – 52.20 g reported in the present study were similar to 44.73 – 57.90 g reported by [43] but were in contrast to the findings of [44] who reported 61.19 – 79.91 g, as values for average daily feed intake. The values in this study were also less than 72.55 – 81.64 g by [19] for rabbits fed varying levels of rumen content and blood meal mixtures. The average daily weight gain recorded in this study (6.22 – 7.61 g) is slightly lower than 8.69 – 11.07 g by [27], 42.76 – 45.16 by [19] but similar with and 2.71 – 9.24 g reported by [5]. Values obtained in this study were lower than 19.96 - 23.26 g reported by [45]. Feed conversion ratio of 2.87 – 3.54 reported by [45] were better than those reported in this study. Values for FCR reported in this study were comparable with [44]. The FCR values of 6.02 – 7.71 is higher than the reported value of 4.23 – 5.84 posited by [27], 1.62 – 1.87 by [19], but agreed with and can be compared with 6.01 – 8.00 reported by [46], 6.72 – 6.90 by [47] who fed rabbits with rumen contents in place of maize. The similarities in feed conversion ratio of the rabbits on this trial is an indication that, the inclusion of SCRD in the diets of growing rabbits did not impair nutrient utilization in the growing rabbits. This is in agreement with [27] and [19] who opined a similar trend in weaner rabbits fed rumen contents as replacement for maize. However, FCR values observed in this study showed that, control diet is not significantly ($P>0.05$) different from those fed the experimental diets. The result of the feed conversion ratio (FCR) showed that though the effect of dietary treatment was not significantly ($P > 0.05$) different, rabbits fed diet T5 better utilized their diets than those on diets T1, T2, T3 and T4.

Disparities observed in the result of the present study and those of previous researchers could be due to differences in experimental procedures, dietary effect, size and age of experimental animals used and environmental conditions. The non-significant ($P>0.05$) differences in the growth performance observed in this study is an indication that the experimental diets supplied adequate nutrients which supported and had no adverse effect on growth performance of the rabbits.

The result of feed cost analysis of rabbits fed diets containing SCRD is presented in Table 5. The feed cost analysis of rabbit bucks to diets containing graded levels of sun-dried cattle rumen digesta showed that the cost per kg diet was higher in the control diet ₦ 76.15 following a definite pattern by decreasing at inclusion of SCRCD to T5 (₦ 56.45). Values recorded were 76.15, 71.26, 69.70, 69.22 and 56.45 at 0, 5, 10, 15 and 20 % respectively. This may not be unconnected to the fact that SCRD is cheaper than maize. The findings of this study also align with the earlier reports of [27] for rabbits fed goat rumen content and [48], who reported decline in cost per kg gain of rabbits fed bovine rumen content. The decline from 0 - 20 % inclusion of SCRD observed in cost of feeding is in line with the previous study of [5], who observed significant decrease in cost/kg diet, cost of feeding and cost/kg weight gain as rabbits were fed Lablab seed as major protein source in diet. [49] who showed decrease in cost of feeding on grower rabbits fed enzyme supplemented dried bovine rumen digesta as replacement for maize. Feed cost per kg weight gain progressively reduce inconsistently from diet T1 (₦ 510.96) to diet T5 (₦ 399.83). This agrees with the findings of [50] that the better feed conversion ratios observed for rabbits fed diets containing graded levels of sun-dried cattle rumen content significantly lowered the feed cost per kg gain as observed in the present study. Similar observations were seen in total cost of production reducing at inclusion on SCRD with T1 (₦ 707.49) progressively reduce in order T4, T2, T3 and T5 had the lowest (₦ 468.02). This study agrees with the feedings of [51], who reported reduction in total cost of production in rabbits fed different types and levels of rumen contents. The significant reduction in cost of feed, feed cost/kg gain, feeding cost and total cost of production in this study can be ascribed to the low cost of obtaining sun-dried cattle rumen digesta and this align with the findings of [52], who said that agricultural by-products that are not directly consumed by man are readily available and cheaper than the conventional feed ingredients. Rabbits fed diets T1 (₦ 958.53) recorded the highest gross revenue and low in T3 (₦ 379.50), however with high profit per live weight recorded in T5 (₦ 486.22) and T3 (₦163.97) recorded the lowest profit per live weight. This shows that, inclusion of SCRD leads to low cost of production, minimizes cost and maximizes profit.

The mean profit rabbit in T5 is capable of dictating the success of a rabbit producer and the profit margin of using sun-dried cattle rumen digesta will likely result in increased production of rabbits thereby bridging the gap of animal protein deficiency in developing countries like Nigeria.

Table 4: Effects of Experimental Diets on Performance of Growing Rabbit Bucks

Parameters	**T1** (0% SCRD)	**T2** (5% SCRD)	**T3** (10% SCRD)	**T4** (15% SCRD)	**T5** (20% SCRD)	**SEM**
Initial Weight (g)	784.64	785.66	780.16	788.67	781.67	133.70
Final Weight (g)	1423.66	1348.17	1303.16	1357.50	1417.83	190.50
Average Daily Feed Intake (g)	51.07	48.37	45.67	52.20	45.62	9.35
Average Daily Weight Gain (g)	7.61	6.69	6.22	6.77	7.57	1.53
Feed Conversion Ratio	6.71	7.22	6.66	7.71	6.02	1.33

SCRD = Sundried Cattle Rumen Digesta. SEM = Standard error of mean.

Table 5: Effects of Experimental diets on Economics of Production

Parameters	**T1**(0% SCRC)	**T2**(5% SCRC)	**T3**(10% SCRC)	**T4**(15% SCRC)	**T5**(20% SCRC)	**SEM**
Average Feed Intake (kg)	5.11	4.83	4.57	5.22	4.56	66.60
Final Weight (g)	1423.67	1348.16	1303.16	1351.50	1417.83	35.35
FCR	6.71	7.22	6.66	7.71	6.06	1.33
$CostKg^{-1}$ Diet (₦)	76.15	71.26	69.70	69.22	56.45	NA
Cost of Feeding (₦)	389.12	344.18	318.53	361.32	257.41	NA
$CostKg^{-1}$ Weight Gain (₦)	510.96	514.49	464.20	533.68	399.83	NA
Total Cost of Production (₦)	707.49	625.78	579.14	656.94	468.02	NA
Revenue (₦)	2135.51	2022.24	1954.74	2027,25	2217.45	NA
Profit (₦)	1428.02	1396.46	1490.74	1371.25	1749.43	NA

NA= Not analyzed, SEM = Standard error of mean.

4. CONCLUSION AND RECOMMENDATION

Processing Sundried cattle rumen digesta may be uninteresting due to its unfavourable smell resulting from microbial fermentation, its low energy content may reduce inclusion rates in rabbit diets. However, it is a good feedstuff for inclusion in rabbit diets as reflected in the nutritional profile of the test material. It relatively improved growth performance of the growing rabbits without adverse effects, and there was a decrease in cost per kg diet as SCRD increased across dietary treatment groups. Therefore, farmers can include sun dried rumen digesta to reduce cost.

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