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Growth performance and economy of feed conversion of weaner rabbits fed rumen content and Chicken intestine mixture

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Abstract
The experiment was designed to evaluate the growth and economy of feed conversion of growing rabbits (Oryctolagus cuniculus) fed diet containing varying levels of sun dried rumen content and chicken intestine mixture (RCCIM). A total of seventy five (75) crossbred weaner rabbits aged 5 – 6 weeks of mixed sexes were used for this experiment. The rabbits were randomly allotted to five treatments in a Completely Randomized Design (CRD). Five experiment diets were formulated comprising of a mixture of sun dried rumen content and chicken intestine mixture (RCCIM) in the ration of 50:50. Treatment one (T1) served as the control with 0 % inclusion level while T2, T3, T4 and T5, T2 were fed 10 % RCCIM, T3 were fed 20 %, RCCIM, T4 were fed 30 % RCCIM and T5 were fed 40 % RCCIM respectively. The result showed that chicken intestine had higher crude protein (22.78 %) and higher energy (2835.62 ME) while the rumen content had higher values in dry matter (91.72 %) and crude fibre (21.48 %). There were no significant difference ($P>0.05$) between the control and T3 over the other treatments in final body weight, however the feed conversion ratio (FCR) of T3 (3.01) was significantly different ($P<0.05$) from the control and other treatments. Similarly, the results shows that rabbits fed 20 % RCCIM recorded significantly ($P<0.05$) higher protein (2.19) and energy efficiency ratios (5.90) over the control and other treatments. The economy of feed conversion revealed that T3 recorded the lowest cost per weight gain (N 786.36) over the control and other treatments. It was therefore concluded that 20 % inclusion of RCCIM in the diet of growing rabbits had a significant difference ($P<0.05$) in the final body weight gain against other treatment groups. It's therefore recommend that 20 % inclusion of RCCIM for growing rabbits enhance weight gain and economy of feed conversion.

Keywords: Weaner rabbits, growth performance, rumen and chicken intestine

Introduction

Livestock production accounts for over 40 % of the value of world agricultural output and they provide one third of human's protein intake (Ojebiyi and Saliu, 2014) [25]. The developing countries are presently consuming far less than the recommended daily animal protein of 45 g/person/day (Adama, 2008) [1]. This development is not only impacting negatively on the health of the citizenry, but also retarding the much desired economic growth. The demand of livestock products is therefore expanding due to the growing populations and incomes along with changing preference (FAO, 2009). Rabbit production is considered esteemed as available means of meeting the animal protein need of the population in developing countries like Nigeria (Jiya, 2012 [15]; Ogbonna, 2015) [24]. Rabbits have high genetic potential, short generation interval, high fecundity, rapid growth rate, high prolificacy and relatively low cost of production (Apori *et al*., 2014) [6].

Rumen contents and chicken intestine are abundantly available in slaughter house/market as by-product and mainly considered as a waste material causing environmental pollution. Rumen content is a waste generated from ruminant animals in slaughter houses such as cattle, sheep and goats (Agolisi *et al*., 2020) [4], even though it is rich in nutrients (Pancapalaga *et al*., 2021) [28]. It is a partially digested forage mainly found in the rumen of ruminant animals that contains gas, fluid, bacteria, protozoa and fungi and is fairly rich in crude protein (Okere, 2016) [26]. Disposal of chicken by-products from slaughtering house poses an environmental concern (Limpisophon *et al*., 2023) [19]. The utilization of abundant chicken by-products, including chicken intestine (37 % of chicken weight) to produce value-added by-products, positively impacts the economy (Lapeña *et al*., 2018). The intestinal parts from chicken have recently gained attention by producing value-added protein (Limpisophon *et al*., 2023) [19]. Chicken intestine contains several kinds of enzymes including cathepsin B, D, H, L, amino peptidases and alkaline protease (Jamdar and Harikumar, 2016) [14].

Materials and methods

Experimental site

The experiment was conducted at the Teaching and Research Farm of the Department of Agricultural Education, School of Vocational Education, Niger State College of Education, Shango, Minna, Nigeria. Niger state College of Education is situated on Latitude 9.6167^0 N and Longitude 6.5667^0 E of the equator with an average annual rainfall of 1100 – 1300mm (43 – 51m) and a temperature range between 22^0C (72^0 F) and 34^0C (93^0 F). It has relative humidity of between 21 and 37 % and situated within Southern Guinea Savanna vegetation zone of Nigeria. It experiences two distinct seasons, the dry season from November to March and raining season from April to October (GIS, 2024).

Source of experimental animal and diets

A total of seventy-five (75) crossbred weaner rabbits aged 5-6 weeks of mixed sexes (60 does and 15 bucks) sourced from the Directorate of Rural development (DRD), ministry of Livestock and Fisheries Development Minna. The feed

ingredients used in the experiment were rumen content, chicken intestine, maize, full fat soybeans, rice bran, fish meal, bone meal, salt, vitamin premix, methionine and lysine. The rumen content was sourced from Minna ultra-modern abattoir while chicken intestines were purchased from the livestock unit of Abdulkadir Kure Ulttra-Modern Market Minna, Niger state. Other feed ingredients, maize, soybeans, fish meal, salt were purchased from the same market. The bone meal, vitamin premix, methionine and lysine were purchased from Firdausi Agrovet Limited, Kpakungu Minna, Niger State.

Processing of rumen content and chicken intestine

The bovine rumen contents were collected from Minna Ultra-modern abattoir where the animals (cattle) were slaughtered. As the rumen was split opened, the contents were emptied into a 32 litres plastic bucket and taken to the experimental site. The content was poured into a plastic container, tied and an average stone of 15kg was put on top to reduce the water content for 90 minutes. The drained rumen content was then heated in a drum on burning firewood at 70 ^{0}C and stirring for 30 minutes, which gave it even heating. The content was thereafter sun dried on a concrete floor until 12 % moisture was attained in accordance to the procedure of Mohammed *et al.* (2010) [22]. All foreign objects (wires, leathers, jute bags etc) were removed from the sundried rumen contents.

The Chicken intestine freed of the kidneys, liver, bile duct, heart, gizzard and crop. The undigested food and faecal matter were flushed out with tap water and the intestine heated for 20 minutes at 40 ^{0}C to reduce the fat content in line with the method of Latif, (2006). The steamed intestine was then sundried and pounded with a pestle in a mortar. A mixture of the rumen content and chicken intestine (RCCIM) was made at the ratio of 50:50 and milled using a hammer mill of 10 mm mesh-size in line with the procedure of Onu *et al*., (2011) [27]. The soybean was soaked in warm water at 45 ^{0}C for 30 minutes and sundried, ground and properly mixed with other ingredients (Lazaro *et al*; 2002) [18] in the ratios as shown in table 1.

Experimental diets

Table 1: Feed composition and calculated nutrients of diet fed to weaner rabbits

Treatments					
Ingredients	**T1 0 % RCCIM**	**T2 10 % RCCIM**	**T3 20 % RCCIM**	**T4 30 % RCCIM**	**T5 40 % RCCIM**
Maize	57.07	55.60	54.15	52.68	51.22
Full Fat Soyabean	21.88	21.16	20.46	19.70	18.98
RCCIM	0.00	2.19	4.34	6.56	8.75
Rice bran	15.00	15.00	15.00	15.00	15.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Salt	0.30	0.30	0.30	0.30	0.30
*Premix	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Calculated Nutrients					
ME (KcalKg)	2913.74	2847.81	2834.02	2821.05	2808.15
Crude protein (%)	17.99	18.40	18.01	17.99	18.01
Crude fibre (%)	10.43	11.12	11.14	11.42	11.46
Ether extract (%)	3.98	4.04	4.04	4.05	4.05
Calcium (%)	1.53	1.54	1.53	1.53	1.54
Phosphorus (%)	0.81	0.80	0.80	0.79	0.79
Methionine (%)	0.49	0.48	0.47	0.47	0.47
Lysine (%)	0.96	1.07	1.07	1.05	1.07

Key: RCCIM (rumen content and chicken intestine mixture)

**Premix will supply the following per kg of premix: Vitamin A, 5000.00 IU; Vitamin D_3 800,000IU; Vitamin E, 12,000 mg; Vitamin K, 1,5000mg; Vitamin B_1, 1,000 mg; Vitamin B_2, 2,000 mg, Vitamin B_6, 1500 mg; Niacin, 12,000 mg; Pantothemic acid, 20.00 mg; Biotin, 10,00 mg; Vitamin B_{12}, 300.00mg; Folic acid, 150,000 mg; Choline, 60,000 mg; Manganese, 10,000 mg; Iron, 15,000 mg; Zinc 800.)) mg; Copper 400.00 mg; Iodine 80.00 mg; Cobalt 40 mg; Selenium 8.00 mg.*

Experimental design

The rabbits were randomly allotted to five treatment (T1, T2, T3, T4 and T5) in a Completely Randomized Design (CRD). Each treatment group had fifteen rabbits comprising of twelve does and three bucks. The treatment were sub-divided into three replicates of five rabbits (four does and one buck) and each rabbit was confined to one cage compartment

Management of experimental weaner rabbits

The rabbits were kept for a period of eight (8) weeks including the two (2) weeks adjustment period. Each rabbit was housed in a separate cage compartment of 65×49×54cm (length, breath and height) and 40cm above the floor. Each compartment had floor space of between 0.41cm, 0.57cm and 56cm length with strong net fitting. The cages were enclosed in a house under intensive management and the floor of the house was cemented. The windows were burglar-proofed and netted while the space between the roof and the wall was netted too against the effect of predators and to enhance ventilation. Before the commencement of the feeding trial, the house and the hutches were thoroughly washed with disinfectants (Dettol) at 2ml/litre of water. Clean galvanized aluminium feeders and drinkers were placed one each in all the cages for feed and water. The rabbits were dewormed with 1-2 ml/kg of Albendazole suspension (orally) against gastro intestinal worm infestation. Ivomectin was injected subcutaneously at 0.02ml/kg (Barger, 2013) [7] while broad spectrum antibiotic (oxytetracycline long acting LA) was injected at 0.01 ml/kg

intramuscularly (IM) against bacterial infection. A teaspoon of vitalyte (ESMOVITA) to four litres of water was administered in drinking water to reduce stress and improve appetite (McMillan, 2014) [20].

Data collection

Data collected includes feed intake, weight gain, feed conversion, protein efficiency ratios and economy of feed conversion.

Data analysis

All data collected were subjected to one way analysis of variance (ANOVA) using Statistical Analytical System (SAS, version 15) while means of significant difference (P<0.05) were separated by Duncan multiple range test (1955).

Results and discussion

Table 2 present results of the dry matter contents of 91.72 % and 90.11 % in rumen content and chicken intestine where rumen content had crude protein of 18.50 % and chicken intestine had 22.78 %. The crude fibre values of rumen content and chicken intestine were 21.48 % and 4.78 % respectively. The metabolizable energy ranges from 2346 ME/Kcal/Kg and 2835.62 ME/Kcal/Kg of rumen content and chicken intestine respectively. This agrees with Alemede *et al*. (2014) [5] who reported crude protein of between 16 – 18 % in bovine rumen digesta. The percentage crude fibre obtained from rumen content and chicken intestine meets the recommended requirement of rabbits and agrees with the finding of Fapohunda *et al*. (2005) [10] and NRC (2007) who reported that crude fibre level above 14 % can affect the energy level of the diet and reduce efficiency. The average composition of RCCIM of crude protein of 20.64% with energy of 2590.91ME/Kcal/kg was recorded respectively, while the crude fibre value of RCCIM was 13.13%. The lower percentage levels of between 6 to 9.5% can increase the incidence of diarrhea, however the the crude protein levels of 18.10 to 18.92 was recorded amongst the treatments, while the crude fibre content was between 10.83 to 12.33 % respespectively, the agrees with Mohammed et al. (2010) [22].

Table 3 shows results of the dry matter content was highest in T4 (95.13 %) and lowest in T2 (94.81 %). The diet crude protein ranged from 18.10 % to 18.92 % and the crude fibre values was highest (9.28 %) in T2 and lowest in T4 (7.90). The metabolizable energy was highest in T4 (3337.25 ME/Kcal/Kg) and lowest in T2 (3218.00 ME/Kcal/Kg). The crude protein values obtained in this study are in agreement with Adama *et al*. (2001) [2] and Ijaiya and Fasanya (2004) [13] who reported crude protein levels of 17 to 18 % in weaner rabbit diet. However, metabolizable energy of the diet in this study was higher than those of Togun *et al*. (2009) [32] 2160.85ME/Kcal/Kg and 2278.50 ME/Kcal/Kg of Dairo *et al*. (2005) [8]. The crude fibre values obtained in this were agreement with Adama *et al*. (2001), Ijaiya and Fasanya (2004) and NRC (2007). Garcia *et al*. (2002) [11] reported that lowers level of CF can increase incidence of diarrhea in rabbits.

The result in table 4 shows the result of total feed intake and average daily feed intake of rabbits fed 30 % RCCIM recorded significant higher values (p<0.05) (45059 and 53.64 g) over other treatments, which was closely followed by rabbits fed 10 % (45025 and 53.60 g) RCCIM. The feed conversion ratio was best (3.01) in rabbits fed 20 % RCCIM. Similarly, rabbits fed 20 and 40 % RCCIM recorded significantly (P < 0.05) higher values in protein efficiency ratio (PER) (5.96 and 5.90) respectively has shown on Table 4. Statistical similarity observed in the values of rabbits fed control diet and those fed 10 and 20 % RCCIM in weight gain could mean that up to 20 % inclusion of RCCIM in the rabbits diet can improve growth performance. This agrees with the findings of Robinson *et al*. (2010) [29] who indicated that weaner rabbits performances better at the final body weight, when fed on adequate and required nutrients in their diets. The better performance of rabbits fed 40 % inclusion of RCCIM in feed conversion ratio agrees with the report of Saleh *et al*. (2005*)* [30] that the higher the weight gain, the lower and better the feed conversion ratio.

Table 5 illustrate results of nutrient digestibility, the dry matter results showed that rabbit fed 10 and 20 % RCCIM differ significantly (P < 0.05) from the control 71.52 and 71.60 (t2) to 72.76 %(t3) as observed in other treatments. The crude protein values also indicated that rabbits fed 40 % RCCI showed significant difference (P < 0.05) of 87.20 % in relation to other treatments. The nitrogen free extract, the total nutrient digestibility (TDN) showed significant values in rabbits fed 40 % RCCI (74.10 %) compared to other treatments. The rabbits fed RCCIM diets were observed with better digestibility over the control in most parameters measured except in crude fibre digestibility (54.60 %). The significant performance (P < 0.05) observed in dry matter (DM) and crude protein (CP) digestibility shows the efficiency of the test ingredient in the diet The efficient utilization of the diets also corroborated the highest values of total digestible nutrient (TDN). This is in line with the findings of Agbede and Aletor (2015) [3] who reported that the amount of protein required in the diet is influenced by its digestibility. The high crude fibre digestibility values recorded in the treatment groups are higher than those reported by Togun *et al*. (2009) [32] who also said that the nature of CF in the diet determines the digestibility pattern in the rabbit which was reflected in this study.

The feed cost (N /kg) of rabbits fed 0 % RCCIM had better cost value (₦245.35) and final weight gain (1520.00 g), however, rabbits fed 20 % RCCIM had the best feed conversion ratio (3.01) . The feed cost per weight gain shows that rabbits feed 20 % RCCIM recorded significantly (P<0.05) the lowest value (₦786.36) compared to the control as presented on Table 6. The rabbits feed RCCIM diets had shown better performance in most of the parameters measured. The significant difference observed (P > 0.05) showed in rabbits fed 10 and 30 % RCCIM over the control treatment in average feed intake could mean that these diets were more nutritious and acceptable than the control diet. Although the fed cost (₦/Kg) was significantly lowest in the control diet, the weight gain was significantly higher in all the rabbits feed with RCCIM diet. This equally confirmed the higher the feed intake the higher weight gain. Mohammed *et al*. (2015) [22] reported non-significant (P>0.05) difference in weight gain, with a corresponding difference in feed intakes in the use of rumen content mixtures in the diet of growing rabbits. The better performance of all the rabbits fed RCCIM over the control in FCR and FC/WG/(₦/kg) is an indication that RCCIM in the diets of weaner rabbits has economic benefits in rabbit production.

Table 2: Proximate composition and energy values of chicken intestine and rumen content

Nutrients	Chicken intestine	Rumen content	Average
Dry matter content (DM) (%)	90.11	91.72	90.92
Crude Protein (CP) (%)	22.78	18.50	20.64
Crude Fibre (CF) (%)	4.78	21.48	13.13
Ether Extract (EE) (%)	2.18	1.84	2.01
Ash (%)	9.26	7.29	8.28
Nitrogen free Extract (NFE) (%)	51.16	42.61	46.89
ME (Kcal/kg)	2835.62	2346.20	2590.91

Key: % - percent; ME - Metabolizable energy; Kcal - Kilo calorie; Kg – Kilogram

Table 3: Proximate composition and calculated energy values of experimental diets fed to weaner rabbits

Parameters	T1	Treatments T2	T3	T4	T5
Dry Matter (DM %)	94.85	94.81	95.04	95.13	94.98
Crude Protein (CP) (%)	18.10	18.45	18.13	18.92	18.27
Crude Fibre (CF) (%)	10.83	11.52	11.71	12.13	12.33
Ether Extract (EE) (%)	6.32	4.36	4.13	4.10	4.67
Ash (%)	4.67	4.20	4.24	4.95	5.34
Nitrogen free Extract (NFE) (%)	61.42	61.47	61.79	60.13	60.07
ME (Kcal/kg)	3261.59	3218.00	3279.89	3273.26	3337.25

Key: % - percent; ME - Metabolizable energy; Kcal - Kilo calorie; Kg – Kilogram; T1 - 0 % rumen content and chicken intestine mixture (RCCIM); T2 - 10 % rumen content and chicken intestine mixture (RCCIM); T3 - 20 % rumen content and chicken intestine mixture (RCCIM); T4 - 30 % rumen content and chicken intestine mixture (RCCIM); T5 - 40 % rumen content and chicken intestine mixture (RCCIM).

Table 4: Growth performance, protein and energy efficiency ratios of weaner rabbits fed varying levels of rumen content and chicken intestine mixture

	Treatments						
Parameters	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**	**P-value**
IBW (g)	620.00	620.00	650.00	620.00	610.00		
FBW (g)	1520.00^{a}	1390.00^{b}	1420.00^{a}	1220^{a}	1240.00^{c}	27.59	0.04
AWG	900.00	770.00	770.00	600.00	630.00	0.00	0.00
TFI (g)	43445.00^{c}	45025.00^{b}	43035.00^{d}	45059.00^{a}	42117.00^{c}	307.26	0.01
ADFI (g)	51.70^{c}	53.60^{b}	51.23^{d}	53.64^{a}	50.14^{e}	0.37	0..02
WWG (g)	112.50^{e}	87.20^{d}	87.50^{b}	75.00^{a}	78.75^{c}	0.34	0.01
ADWG (g)	16.07e	13.75^{d}	13.75^{b}	10.71^{a}	11.25^{c}	0.05	0.00
FCR	3.69^{e}	3.57^{d}	3.01^{a}	3.07^{c}	3.04^{b}	0.08	0.03
PER	1.79^{d}	$1. 85^{c}$	2.19^{a}	2.16^{b}	2.18^{a}	0.05	0.02
EER	4.99^{e}	5.36^{d}	5.90^{c}	5.96^{a}	5.61^{c}	0.10	0.00

Key: ^{abcde} means with different superscripts on the same row differs significantly (P<0.05). SEM - Standard error of mean; P-value - probability value; IBW - Initial body weight; FBW - final body weight; AWG - Weight gain; TFI - Total feed intake; ADFI - Average daily feed intake; WWG - weekly weight gain; ADWG - Average daily weight gain; FCR- feed conversion ratio; PER - Protein efficiency ratio; EER - Energy efficiency ratio; T1 - 0 % rumen content and chicken intestine mixture (RCCIM); T2 - 10 % rumen content and chicken intestine mixture (RCCIM); T3 - 20 % rumen content and chicken intestine mixture (RCCIM); T4 - 30 % rumen content and chicken intestine mixture (RCCIM); T5 - 40 % rumen content and chicken intestine mixture (RCCIM).

Table 5: Apparent nutrient digestibility of weaner rabbits fed varying level of rumen content and Chicken intestine mixture

	Treatments						
Parameters (%)	T1	T2	T3	T4	T5	SEM	P-value
Dry matter	71.52^{c}	72.48^{a}	72.76^{a}	71.60^{bc}	71.99^{b}	0.14	0.01
Crude protein	77.20^{c}	75.92^{e}	72.25^{b}	76.71^{d}	87.20^{a}	1.12	0.00
Crude fibre	54.60^{a}	45.26^{e}	46.23^{d}	41.19^{c}	47.35^{b}	0.89	0.03
Ash	41.78^{c}	41.00^{e}	46.57^{b}	47.61^{a}	41.27^{d}	0.76	0.02
Ether extract	64.36^{c}	64.66^{b}	64.79^{a}	64.01^{e}	64.05^{d}	0.08	0.00
NFE	61.74^{e}	62.81^{d}	64.46^{c}	65.52^{b}	65.92^{a}	0.43	0.02
TDN	68.56^{c}	66.28^{e}	$70. 14^{b}$	66.71^{d}	74.10^{a}	0.72	0.04

Key: ^{abcde} means with different superscripts on the same row differs significantly (P<0.05). SEM - Standard error of mean; P-value - probability value; NFE - Nitrogen free extract; TDN - Total digestible nutrient; T1 - 0 % rumen content and chicken intestine mixture (RCCIM); T2 - 10 % rumen content and chicken intestine mixture (RCCIM); T3 - 20 % rumen content and chicken intestine mixture (RCCIM); T4 - 30 % rumen content and chicken intestine mixture (RCCIM); T5 - 40 % rumen content and chicken intestine mixture (RCCIM).

Table 6: Economy of feed conversion of weaner rabbits fed diets containing varying levels of rumen content and chicken intestine mixture

	Treatments						
Parameters	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**	**P-value**
Average feed intake	43445.00^{c}	45025.00^{b}	43035.00^{d}	45059.00^{a}	42117.00^{e}	307.26	0.00
Feed cost (₦/Kg)	245.34^{a}	253.28^{b}	261.25^{c}	269.22^{d}	277.20^{e}	3.01	0.00
Initial weight (g)	620^{b}	620^{b}	650^{a}	620^{b}	610^{b}	0.00	0.01
Final weight (g)	1520.00^{a}	1390.00^{c}	1420.00^{b}	1220.00^{d}	1420.00^{b}	26.05	0.02
Average Weight gain (g)	14.00^{e}	15.00^{d}	17.00^{b}	17.47^{a}	16.47^{c}	0.35	0.03
FCR	3.69^{e}	3.57^{d}	3.01^{a}	3.07^{c}	3.04^{b}	0.08	0.01
FC/WG(₦/Kg)	905.30^{e}	904.21^{d}	786.36^{a}	826.51^{b}	842.69^{c}	12.31	0.00

Key: ^{abcde} means with different superscripts on the same row differs significantly (P<0.05). SEM - Standard error of mean; P-value - probability value; FCR = feed conversion ratio; FC/AWG = feed cost per body weight; T1 - 0 % rumen content and chicken intestine mixture (RCCIM); T2 - 10 % rumen content and chicken intestine mixture (RCCIM); T3 - 20 % rumen content and chicken intestine mixture (RCCIM); T4 - 30 % rumen content and chicken intestine mixture (RCCIM); T5 - 40 % rumen content and chicken intestine mixture (RCCIM).

Conclusion

The study investigated the nutritional composition and utilization of rumen content and chicken intestine mixtures (RCCMI) as an alternative protein and energy sources in rabbit diets. Results from the proximate composition revealed that chicken intestine had a higher crude protein (22.78%) and metabolizable energy (2835.62 ME/Kcal/Kg) compared to rumen content, although the latter had a higher crude fibre value (21.48%).The RCCIM gave a crude protein level of 20.64 with energy of 2590.91ME/kcal/kg. Both materials met the nutritional requirements for rabbit feeding as recommended by NRC (2007). Diets formulated with varying levels of RCCIM showed that the inclusion of up to 20–30% RCCI significantly improved feed intake, protein and efficiency ratios (PER and EER), feed conversion ratio (FCR), and nutrient digestibility. The 20% RCCIM inclusion demonstrated the best FCR (3.01) and lowest feed cost per weight gain (₦786.36), while 30% RCCIM inclusion led to the highest average daily feed intake and weight gain while nutrient digestibility was enhanced in rabbits fed RCCIM diets, especially in crude protein and total digestible nutrients, indicating efficient utilization of the diets. The experiment confirms that RCCIM is a viable and cost-effective alternative feedstuff in rabbit nutrition, promoting growth performance and nutrient efficiency.

References

1. Adama TZ. Towards adequate animal protein intake by year 2020 (Inaugural lecture series No. 11). Federal University of Technology, Minna, Niger State, Nigeria, 2008.
2. Adama TZ, Ijaiya AT, Ayanwale BA, Onotu DA. Effect of age and type of diets on dry matter digestibility in growing rabbits. Journal of Science Technology and Mathematics Education,2001:4(1):171–178.
3. Agbede JO, Aletor VA. Indigenizing the poultry industry in Africa. In Proceedings of the International Workshop on Rural Poultry Development in Africa,19–23. Africa Network on Rural Poultry Development, Ile-Ife, Nigeria,2015.
4. Agolisi HM, Abonuusum A, Jacob A. Nutritional value of dried rumen digesta from cattle, sheep and goat: A case of Bolgatanga abattoir, Ghana. Volta Journal of Science and Technology,2020:2(1):8–15.
5. Alemede IC, Aremu A, Oriade I, Ijaiya AT. Reproductive performance of rabbits (*Oryctolagus cunniculus*) fed diets containing varying levels of dried bovine rumen digesta. Advances in Life Science and Technology,2014:23:1–7.
6. Apori SO, Hagan JK, Osei D. The growth and reproductive performance of different breeds of rabbits kept under warm and humid environments in Ghana. Online Journal of Animal Feed Research,2014:4(3):51–59.
7. Barger E. The 28-day myth. Precast.org,2013. https://precast.org/2013/10/28-day-myth
8. Dairo FAS, Aina OO, Asafa AR. Performance evaluation of growing rabbits fed varying levels of rumen content and blood rumen content mixture. Nigerian Journal of Animal Production,2005:32(1):67–72.
9. FAO. Livestock keepers – Guardians of biodiversity. Animal Production and Health Paper No. 167. Rome, Italy,2009.
10. Fapohunda JB, Adejinmi OO, Ogunleke FO. Performance characteristics of weaned rabbits fed varying levels of cassava leaf meal. In Proceedings of the 10th Annual Conference of the Animal Science Association of Nigeria,295–297. University of Ado-Ekiti, Nigeria,2005.
11. Garcia J, Nicodemus N, Carabano R, De Blas JC. Effect of inclusion of defatted grape seed meal in the diet on digestion and performance of growing rabbits. Journal of Animal Science,2002:69:1566–1574.
12. GIS Development Team. GIS geographic information system. QGIS Software,2024. https://www.qgis.org
13. Ijaiya AT, Fasanya OOA. Effect of varying levels of dietary protein on the carcass characteristics of growing rabbits. Nigerian Journal of Animal Production,2004:13(2):207–210.
14. Jamdar SN, Harikumar P. Purification, identification and characterization of aspartic proteases of chicken intestine. Food Chemistry,2016:199:223–230.
15. Jiya EZ. Performance and organoleptic qualities of rabbits (*Oryctolagus cunniculus*) fed graded levels of processed Tallow (*Detarium microcarpum*) seed meal (Unpublished PhD thesis). Department of Animal Production, Federal University of Technology, Minna, Nigeria,2012.
16. Kamil L. Evaluation of chicken intestine waste as a feed ingredient for Red Tilapia (*Oreochromis* sp.) juveniles (Master's thesis). University of Patra, Malaysia, 2006.

17. Lapeña D, Vuoristo KS, Kosa G, Horn SJ, Eijsink VGH. Comparative assessment of enzymatic hydrolysis for valorization of different protein-rich industrial by products. Journal of Agricultural and Food Chemistry,2018:66(37):9738–9749.
18. Lazaro R, Mateos GG, Latorre MA, Piquer J. Whole soybeans in diets for poultry. http://www.thepoultrysite.com/articles/whole-soybeans-in-diets-for-poultry,2002.
19. Limpisophon K, Hirunrattana P, Prachom N. Valorization of chicken intestine: A process of protein hydrolysate for fish feed attractant using pilot plant scale system. Animal Feed Science and Technology,2023:296:115554.
20. McMillan JH. Classroom assessment: Principles and practice for effective standards-based instruction (5th ed.). Pearson,2014.
21. Mohamed LA, Tachikawa H, Gao XD, Nakanishi H. Yeast cell-based analysis of human lactate dehydrogenase isoforms. Journal of Biochemistry,2015:158(6):467–476.
22. Mohammed G, Igwebinke JU, Alade NK. Performance of growing rabbits fed graded levels of bovine blood–rumen content mixture. Agriculture and Biology Journal of North America,2010:1(6):1233–1237.
23. National Research Council (NRC). Nutrient requirements of small ruminants: Sheep, goats, cervids, and New World camelids. The National Academies Press, 2007.
24. Ogbonna OI. Role of households in rabbit production in Enugu-North Agricultural Zone of Enugu State. Journal of Agricultural Extension,2015:19(1):49–56.
25. Ojebiyi OO, Saliu AS. Effect of feeding bovine rumen content blood meal (50:50) mixtures on performance and slaughter characteristics of growing rabbits. The Journal of Animal and Plant Sciences,2014:24(2):430–434.
26. Okere SE. Evaluating rumen digesta as a source of plant nutrient in Owerri Southeast, Nigeria. Academic Journal of Science,2016:5(1):221–226.
27. Onu PN, Otuma MO, Odukwe CA, Aniebo AO. Effects of different levels of bovine blood/rumen content mixture on performance, carcass characteristics and economics of production of finisher broilers. International Journal of Animal and Veterinary Advances,2011:1(1):10–16.
28. Pancapalaga W, Suyatno, Sedlacek D. The use of rumen contents as bio–activators for fermentation in goat manure fertilizer production. E3S Web of Conferences,2021:226:00048.
29. Robinson DH, Davidson WJ, Spreadbury DD. Nutrition of New Zealand White rabbits production. Society Journal of Rabbit Production,2010:24:75–83.
30. Saleh GT, Abdullahi HB, Osinowo OA. Growth rates of three breeds of rabbits in NAPRI Shika. In 17th Annual Conference of the Nigeria Society for Animal Production,1992. Abuja: Sheraton Hotel & Towers.
31. SAS Institute Inc. SAS user's guide. SAS Institute Inc,2015.
32. Togun VA, Farinu GO, Ojebiyi OO, Awotunde AI. Effect of replacing maize with a mixture of rumen content and blood meal on the performances of growing rabbits: Initial study with mash feed. World Rabbit Science,2009:17(1):21–26.
33. Waldroup PW. Whole soybeans for poultry feeds. Worlds Poultry Science Journal,1982:38(1):28–35.