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EFFECTS OF GENOTYPE AND QUANTITATIVE FEED RESTRICTION ON THE POST-WEANING GROWTH TRAITS OF RABBITS

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SUMMARY

The purpose of this paper is to determine the effects of four genotypes and four different quantitative feeding regimes on the post-weaning average feed intake (AFI), body weight (BW), weight gain (WG) and feed conversion ratio (FCR) of 48 unsexed weaner rabbits. At weaning, a total of 3 rabbits from each genotype considered, namely the purebred Chinchilla and New Zealand White (CH x CH, NZW x NZW) and their reciprocal crossbreds (CH x NZW, NZW x CH), were randomly assigned to four feeding regimes: ad libitum concentrate + ad libitum forage (A), ad libitum concentrate + 30% restricted forage (B), 30% restricted concentrate + ad libitum forage (C), and 30% restricted concentrate + 30% restricted forage (D). The data were subjected to a two-way analysis of variance in a completely randomized design appropriate for a 4x4 factorial experiment. The experiment was conducted over a period of 5 weeks: from 7 to 11 weeks post-weaning. The AFI values obtained from the interactions between CH x CH and the C feeding regime at 7 weeks post-weaning (366.50 ± 1.50 g), and between NZW x NZW and the B feeding regime at 8 weeks (324.00 ± 1. 00 g) and 10 weeks post-weaning (336.50 ± 0.00 g) were similar, but differed significantly ($P < 0.05$) from the rest. The lowest significant AFI values ($P < 0.05$) at all ages and FCR values (3.46 ± 0.33) at 9 weeks post-weaning were obtained from NZW x NZW, whereas the highest BW values at 9-11 weeks post-weaning was obtained from CH x CH. The lowest significant AFI values ($P < 0.05$) were recorded in the B feeding regime at 7-11 weeks post-weaning, as well as the highest BW and WG values in the A feeding regime at 8–11 and 11 weeks post-weaning, respectively. Moreover, the highest significant BW values (781.25 ± 7.83) were recorded in the C feeding regime at 7 weeks post-weaning. It was concluded that the interactions between CH x CH and the C feeding regime and between NZW x NZW and the B feeding regime can significantly reduce the overall feed intake, thus invariably increasing profit in rabbit production.

Key words: *feeding regime, genotype, growth, interaction, rabbit*

INTRODUCTION

The overwhelming animal protein deficiency common in most developing countries is yet to be alleviated (Obike & Ibe, 2010). This deficiency arises from the fact that the human population growth in developed countries is stabilizing while that in developing countries (including Nigeria) is increasing (Mailafia et al., 2010). Therefore, the search for alternative sources of animal protein to meet the population growth challenges is necessitated. Rabbit production is a veritable way of alleviating animal protein deficiency in Nigeria. Rabbits are renowned for their high prolificacy, short gestation period, fast growth rate, high conversion ratio, low cholesterol content and less space requirement compared to other farm animal species (Gono et al., 2013). However, rabbit production is faced with a number of challenges including the scarcity of pure breed, high costs of commercial feed and limited forages due to an increase in the non-agricultural use of land in urban and sub-urban areas.

It is well known that genotypes cannot realize their full potential without profitable interaction with the environment (Chineke, 2005; MacNeil et al., 2017), of which feed is an important component. This has necessitated alternatives that can combine genotype and restricted feeding as factors in improving the growth performance of rabbits. A number of studies have dealt with the effect of either genotype (Awe & Chineke, 2016; Onasanya et al., 2017; Assan, 2018) or feed restriction on rabbit growth performance (Gidenne et al., 2008; De Oliveira et al., 2012). Most studies on feed restrictions in rabbits focused on the use of concentrates.

However, virtually no research has examined the alternating use of restricted concentrate with *ad libitum* forage and vice versa, or combining both genotype and quantitative feed regimes in rabbits. As concentrates are expensive for average farmers and forages can supplement rabbit feeds at acheap price, it is necessary to formulate a feeding regime that will combine concentrates with forages at the optimum cost and maximum production. Quantitative feed restriction has the capacity to reduce feed intake (Tumova et al., 2002; Van der Klein et al. 2007), which will invariably reduce the costs of commercial feed and the total costs of animal production (Nwachukwu & Ibe, 1990). Any study aimed at producing high-quality rabbit breeds or crossbreds by reducing feed intake and the total cost of production will be profitable to rabbit farmers, especially with the current global increase in the costs of commercial feeds (Taru et al., 2010, Fafiolu & Alabi, 2020). The objective of this study was to determine the effects of genotype and different quantitative feeding regimes on the growth performance of young rabbits.

MATERIAL AND METHODS

The experiment was carried out in the Rabbitry Unit of the Teaching and Research Farm, Abia State University, Umuhia Campus. The campus is located at a latitude of 05°29´ N, a longitude of 07°33´ E, and an altitude of 122 m. The area lies within the tropical rainforest zone of Nigeria, characterized by an annual rainfall approximating to 2,177 mm, an ambient temperature ranging from 27 to 36 °C and from 20 to 26 °C during hot and dry seasons and cold and rainy seasons respectively, and a relative humidity of 57–97% (Nwaogwugwu et al., 2009).

Experimental animals and their management

A base population of 18 rabbits, consisting of the New Zealand White (NZW) and Chinchilla (CH) breeds, were purchased from ADP, Umuahia, Abia State, and the Ministry of Agriculture, Uyo, AkwaIbom State, Nigeria. A total of 12 clinically sound rabbits (namely 2 bucks and 4 does from each breed considered) were selected from the base population as parents. The parents were mated in a ratio of 1 buck to 2 does. The Chinchilla (CH) and New Zealand White (NZW) breeds were mated to produce the CH x CH and NZW x NZW pure crosses. The breeds were in turn used to mate with each other to produce the CH x NZW and NZW x CH reciprocal crosses. Mating was done in the morning hours by introducing the does to the bucks' pens. They were left together for 2 to 3 days to ensure successful mating. The does were palpated at the 14^{th} day post coitus to ascertain pregnancy. The non-pregnant does were immediately re-mated. A total of 70 F_1 kits made up of 16 CH x CH, 20 NZW x NZW, 17 CH x NZW and17 NZW x CH were produced at birth. The animals were managed in individual hutches and metal row cages. Clean and cool water was provided *ad libitum*. The expectant does were provided with kindling boxes 28 days into the gestation period. Upon kindling, the litters were inspected for stillbirths and retained foetuses. The parent animals were injected with ivormectin subcutaneously against internal parasites. The streptopenviscoplex-forte (vitamin and mineral premix) injection was administered to the does intramuscularly against mastitis after kindling. The kits were weaned at 6 weeks of age.

At weaning,four feeding regimes were designed and administered to the animals: *ad libitum* concentrate + *ad libitum* forage (A), *ad libitum* concentrate + 30% restricted forage (B), 30% restricted concentrate + *ad libitum* forage (C), and 30% restricted concentrate + 30% restricted forage (D). At this stage, three offspring from each of the four genotypes considered were randomly selected from the litter and assigned to one of the four feeding regimes. Consequently, a total of forty-eight rabbits were used in the experiment, i.e. twelve rabbits from each genotype considered. The percentage of concentrate and forage fed to the restricted groups was determined according to the total intake of full-fed animals the previous day. The rabbits were fed commercial concentrates containing 2,650 kcal/kg ME and 19% crude protein (CP) together with mixed forages containing *Calopogonium mucunoides*, *Aspilia* *africana, Centrosema pubescens, Panicum maximum* and *Amaranthus cruentus*. The feed was administered on the basis of the four feeding regimes considered.

Data collection and trait measurement

Data on the rabbits' average feed intake (AFI) and body weight (BWT) were collected once a week, from which their weight gain (WG) and feed conversion ratio (FCR) were computed. Body weight values were measured on an individual basis, using a 5 kg weighing scale (Model SP) with a sensitivity of 0.01 g.

Experimental design

A 4 x 4 factorial experiment was carried out in a completely randomized design. The factors were the genotypes and feeding regimes considered, each having 4 levels. The data obtained were fitted to the model as shown in Equation 1.

$$Y_{ijk} = \mu + F_i + G_j + (FxG)_{ij} + \varepsilon_{ijk} \quad (1)$$

where Y_{ijk} is the observation made on the *k* progeny of the *j* genotype in the *i* feeding regime, F_i is the feeding regime effect (i = 1,2, 3 and 4), G_j is the genotype effect (i = 1,2, 3 and 4), $(F \times G)_{ij}$ is the interaction effect between the feeding regime and the genotype, and ε_{ijk} is the random error. All the effects were analyzed using an analysis of variance and tested using the SAS (1999) softwareat a 5% significance level. The means of significant interactions and main effects were separated by the Duncan New Multiple Range Test built within the SAS (1999) software.

RESULTS AND DISCUSSION

The least square means of feed intake of the rabbit genotypes considered as influenced by the genotype x feeding regime interaction (7-11 weeks) is presented in Table 1. There was a significant ($P < 0.05$) genotype x feeding regime interaction effect on the average feed intake of the rabbits genotypes at 7, 8 and 10 weeks of age (Tab. 1). The lowest average feed intake was obtained from the interaction between CH x CH in the feeding regime involving 30% restricted concentrate + *ad libitum* forage (366.50 ± 1.50 g) at week 7 post-weaning and between NZW x NZW in the *ad libitum* concentrate + 30 % restricted forage feeding regime at 8 (324.00 ± 1.00 g) and 10 (336.50 ± 0.00 g) weeks post-weaning. Although no significant difference ($P > 0.05$) occurred at week 11 post-weaning, NZW x NZW fed 30% restricted concentrate + 30% restricted forage and CH x CH fed 30% restricted concentrate + *ad libitum* forage consumed the smallest average amount of feed.

Table 1. Least square means of average feed intake (g) of the rabbit crosses as influenced by the interaction between the genotype and feeding regime considered (7-11 weeks)

Genotype	Feed regime	Age (weeks)				
		7	8	9	10	11
NZW x NZW	A	382.50±2.50[h]	392.50±1.00[h]	397.50±0.00	402.00±0.00[i]	408.50±1.50
	B	419.50±1.50[e]	324.00±1.00[l]	330.50±0.00	336.50±0.00[k]	402.00±2.00
	C	382.00±1.00[h]	390.00±50.00[h]	397.50±0.00	401.50±0.00[i]	410.00±1.00
	D	371.00±0.00[i]	377.00±2.50[j]	382.00±0.00	382.00±0.00[j]	396.00±0.00
NZW x CH	A	484.50 ± 1.50[a]	491.00±1.00[a]	496.50±1.50	501.00±2.00[ab]	512.00±1.00
	B	419.50±0.50[e]	428.00±1.00[e]	431.00±1.00	437.00±2.00[f]	443.00±2.00
	C	474.50±1.50[b]	482.50±50.00[a]	486.00±1.00	494.50±0.50[b]	448.50±48.50
	D	471.50±0.50[b]	480.00±2.50[b]	432.50±52.30	489.50±57.50[c]	448.00±50.00
CH x CH	A	485.50±0.50[a]	490.50±0.50[a]	452.50±1.00	503.00±2.00[a]	510.00±2.00
	B	419.00±1.00[e]	428.50±1.50[e]	431.50±1.50	439.00±1.00[f]	445.00±2.00
	C	366.50±1.50[i]	373.00±1.00[k]	481.50±1.50	388.00±2.00[j]	396.50±1.50
	D	411.00±30.00[f]	418.00±32.00[f]	452.50±30.50	426.50±30.00[g]	463.00±2.80
CH x NZW	A	433.50±1.50[d]	437.50±0.50[d]	442.00±2.00	449.99±2.00[e]	455.00±3.00
	B	397.50±1.50[g]	402.50±2.50[g]	410.50±0.50	416.00±1.00[h]	422.00±2.00
	C	447.50±0.50[c]	453.00±1.00[c]	465.50±1.00	465.50±1.50[d]	473.00±2.00
	D	390.00±11.00[h]	384.00±11.50[i]	400.66±9.60	397.50±9.20[i]	413.66±9.20

Legend: Values in the same column with different letters differ significantly ($P < 0.05$); A = *Ad libitum* concentrate + *Ad libitum*forage; B = *Ad libitum* concentrate + 30% restricted forage; C = 30% restricted concentrate + *Ad libitum* forage; D = 30% restricted concentrate + 30% restricted forage

Tables 2-4 present the least square mean body weight, weight gain and feed conversion ratio of the rabbits as influenced by the genotype x feeding regime interaction effects (7-11 weeks). There was no significant (P > 0.05) genotype x feeding regime interaction effect on the traits in all the weeks considered. However, it was observed that the interaction between CH x CH and the *ad libitum* concentrate + *ad libitum* forage feeding regime resulted in the highest numerical body weight followed by that of NZW x NZW with the *ad libitum* concentrate + *ad libitum* forge feeding regime in both weeks 7 and 11 post-weaning. The feed intake, body weight, weight gain and feed conversion ratio obtained from the genotypes by feeding regime interaction effects ranged from 366.50 ± 1.50 g–396.00 ± 0.00 g, 737.50–1475.00 ± 25.00 g, 87.50 ± 12.50–225.00 ± 25.00 g and 4.85 ± 0,02–1.93 ± 0.12 from 7 to 11 weeks of age, respectively.

Table 2.Least square means of body weights (g) of the rabbit crosses influenced by the interaction between the genotype and feeding regime considered (7-11 weeks)

Genotype	Feed regime	Age (weeks)				
		7	8	9	10	11
NZW x NZW	A	787.50±12.50	887.50 ±12.50	1012.50±12.50	1200.00±2.50	1400.00±25.00
	B	737.50±12.50	862.50±12.50	975.00±0.00	1075.00±2.50	1250.00±50.00
	C	775.00±25.00	887.50±12.50	975.00±25.00	1125.00±25.00	1300.00±0.00
	D	775.00±0.00	850.00±0.00	975.00±0.00	1050.00±25.00	1250.00±0.00
NZW x CH	A	775.00±25.00	912.50±12.50	1012.50±12.50	1187.50±12.50	1387.00±12.50
	B	775.00±0.00	887.50±12.50	987.50±37.50	1065.50±12.50	1275.00±25.00
	C	787.50±12.50	900.00±25.00	987.50±12.50	1125.00±25.00	1312.50±12.50
	D	737.50±12.50	850.00±25.00	1012.50±25.00	1050.00±25.00	1212.50±12.50
CH x CH	A	837.50±12.50	937.50±12.50	1125.00±50.00	1250.00±50.00	1475.00±25.00
	B	812.50±12.50	912.50±12.50	1025.00±25.00	1175.00±25.00	1362.50±12.50
	C	787.50±12.50	912.50±12.50	1037.50±12.50	1187.50±12.50	1387.50±12.50
	D	775.00±50.00	875.00±50.00	1012.50±87.50	1137.50±87.50	1325.00±75.00
CH x NZW	A	775.00±25.00	887.50±37.50	1.25.00±25.00	1175.00±0.00	1387.50±12.50
	B	737.50±12.50	850.00±0.00	1012.50±12.50	1162.50±12.50	1325.00±12.50
	C	775.00±25.00	887.50±12.50	1125.00±25.00	1125.00±25.00	1325.00±0.00
	D	775.00±25.00	875.00±14.40	1125.00±38.10	1125.00±38.10	1308.33±8.30

Legend: A = *Ad libitum* concentrate + *Ad libitum* forage; B = *Ad libitum* concentrate + 30% restricted forage; C = 30% restricted concentrate + *Ad libitum* forage; D = 30% restricted concentrate + 30% restricted forage

Table 3. Least square means of weight gains (g) of the rabbit crosses influenced by the interaction between the genotype and feeding regime considered (7-11 weeks)

Genotype	Feed regime	Age (weeks)				
		7	8	9	10	11
NZW x NZW	A	127.50±2.50	100.00. ±0.00	125.00±0.00	187.50±12.50	212.50±12.50
	B	87.50±12.50	125.50±12.50	112.50±12.50	100.00±25.00	175.00±25.00
	C	112.50±12.50	87.50±12.50	87.50±12.50	150.00±0.00	175.00±25.00
	D	100.00±0.00	75.00±0.00	100.00±0.00	125.00±12.00	150.00±0.00
NZW x CH	A	100.00±1.50	137.50±12.50	100.00±12.50	175.00±0.00	200.00±25.00
	B	100.00±0.50	112.50±12.50	100.00±25.00	125.00±0.00	162.50±12.50
	C	112.50±1.50	112.50±12.50	87.50±12.50	137.50±12.50	187.50±12.50
	D	112.50±50.50	112.50±12.50	75.00±0.00	125.00±0.00	162.50±12.50
CH x CH	A	137.50±0.50	100.00±0.00	187.50±37.50	125.00±0.00	225.00±25.00
	B	112.50±1.50	100.00±12.50	112.50±12.50	150.00±0.00	187.50±12.50
	C	100.00±1.50	125.00±0.00	125.00. ±0.00	150.00±0.00	200.00±0.00
	D	112.50±30.00	100.00±0.00	150.00±37.50	125.00±0.00	187.50±12.50
CH x NZW	A	112.50±1.50	112.50±12.50	137.50±12.50	150.00±25.00	212.50±12.50
	B	100.00±1.50	112.50±12.50	112,50±37.50	150.00±0.00	162.50±12.50
	C	125.00±0.50	112.50±12.50	112.50±37.50	125.00±25.00	200.00±0.00
	D	108.33±11.00	133.33±8.33	100.33±8.33	133.00±16.60	183.33±8.33

Legend: A = *Ad libitum* concentrate + *Ad libitum* forage; B = *Ad libitum* concentrate + 30% restricted forage; C = 30% restricted concentrate + *Ad libitum* forage; D = 30% restricted concentrate + 30% restricted forage

Table 4. Least square means of feed conversion ratio of the rabbit crosses as influenced by the interaction between the genotype and feeding regime considered (7-11 weeks)

Genotype	Feed regime	Age (weeks)				
		7	8	9	10	11
NZW x NZW	A	3.00±0.07	3.93±0.01	3.18±0.00	2.15±0.15	1.93±0.12
	B	3.69±0.51	2.59±0.01	2.97±0.33	3.59±0.90	2.35±0.35
	C	3.44±0.34	3.51±0.040	4.64±0.67	2.68±0.01	2.39±0.35
	D	3.71±0.00	5.03±0.00	3.06±0.00	3.11±0.00	2.64±0.00
NZW x CH	A	4.85±0.02	3.60±0.33	4.97±0.02	2.86±0.01	2.60±0.00
	B	4.47±1.11	3.85±0.44	4.60±1.14	3.50±0.01	2.74±0.22
	C	4.27±0.46	4.34±0.49	5.67±0.82	3.63±0.33	2.38±0.09
	D	3.85±0.88	3.81±0.02	5.77±0.70	3.47±0.46	2.79±0.52
CH x CH	A	3.56±0.34	4.91±0.01	2.76±0.55	4.02±0.02	2.30±0.26
	B	3.77±0.43	4.58±1.16	3.88±0.42	2.93±0.01	2.39±0.16
	C	3.67±0.01	3.36±0.36	3.85±0.01	2.59±0.01	1.98±0.01
	D	4.50±1.77	3.80±1.02	3.62±1.21	3.66±0.24	2.47±0.02
CH x NZW	A	3.90±0.42	3.50±0.00	3.24±0.28	3.80±0.49	2.15±0.14
	B	3.98±0.02	4.03±0.03	4.10±1.36	2.77±0.01	2.61±0.19
	C	3.73±0.74	3.62±0.01	4.59±1.52	3.88±0.78	2.37±0.01
	D	3.63±0.16	3.45±0.37	3.73±0.18	3.15±9.42	2.27±0.13

Legend: A = *Ad libitum* concentrate + *Ad libitum* forage; B = *Ad libitum* concentrate + 30% restricted forage; C = 30% restricted concentrate + *Ad libitum* forage; D = 30% restricted concentrate + 30% restricted forage

The least square means of the growth traits of the rabbit crosses as influenced by the genotype are presented in Table 5. The feed intake (7-11 weeks), body weight (9-11 weeks), weight gain (week 9) and feed conversion ratio (week 9) values differed significantly (P < 0.05) across the rabbit genotypes considered. The means of average feed intake, body weight, weight gain and feed conversion ratio of different genotypes examined ranged from 363.00 ± 11.8 3–462.87 ± 17.00 g, 757.29 ± 9.17–1387.50 ± 25.87 g, 106.25 ± 6.25–200.00 ± 8.18 g and 4.16 ± 0.33–2.28 ± 0.09, respectively. The pure New Zealand rabbits had the lowest feed intake at 7-11 weeks post-weaning and the lowest feed conversion ratio at 9 weeks, whereas the pure Chinchilla rabbits attained the highest body weight and weight gain at 9-11 weeks post-weaning. The body weight of each genotype considered increased with age.

Table 5. Least square means of the growth traits of the rabbit crosses as influenced by the genotypeat post-weaning stages (7–11 weeks)

Age (weeks)	Trait	Genotype			
		NZW x NZW	NZW x CH	CH x CH	CH x NZW
7	AFI (g)	363.00±11.83^{c}	450.25±14.67^{a}	147.75±17.13^{ab}	417.13±9.14^{b}
	BW (g)	768.7510.51	768.75±9.14	803.13±13.72	757.29±9.17
	WG (g)	106.87±7.46	106.25±6.25	115.63±9.38	111.46±6.05
	FCR	3.46±0.18	4.36±0.31	3.87±0.37	3.46±0.15
8	AFI (g)	370.88±12.05^{c}	457.50±14.50^{a}	435.25±17.10^{ab}	422.25±9.07^{b}
	BW (g)	871.88±7.72	887.50±11.57	909.38±13.31	875.00±9.32
	WG (g)	103.13±7.14	118.75±6.25	106.25±6.25	117.70±5.55
	FCR	3.76±0.33	3.90±0.17	4.16±0.33	3.65±0.13
9	AFI (g)	376.87±11.97^{c}	461.50±15.06^{a}	465.62±11.19^{a}	428.04±8.86^{b}
	BW (g)	984.37±9.22^{b}	978.12±15.26^{b}	1050.00±25.87^{a}	1007.29±13.67^{ab}
	WG (g)	112.50±7.43^{ab}	90.62±6.58^{b}	140.62±14.89^{a}	117.7±10.21^{ab}
	FCR	3.46±0.33^{b}	5.25±0.35^{a}	3.53±0.31^{b}	3.91±0.38^{b}
10	AFI (g)	382.25±11.71^{c}	466.50±16.09b	447.00±16.59^{ab}	434.29±8.95^{b}
	BW (g)	1125.00±22.11^{b}	1105.25±22.03^{b}	1187.50±25.0^{a}	1146.87±114.29^{ab}
	WG (g)	140.62±15.15	140.62±86.09	137.50±4.72	139.58±8.44
	FCR	2.88±0.30	3.36±0.15	3.30±0.22	3.22±0.24
11	AFI (g)	404.12±2.11^{b}	462.87±17.00^{a}	453.62±16.25^{a}	440.91±9.02^{b}
	BW (g)	1300.0028.19^{c}	1296.87±24.75^{c}	1387.50±25.87^{a}	1336.45±15.59^{b}
	WG (g)	178.12±11.84	178.12±8.75	200.00±8.18	189.58±7.34
	FCR	2.32±0.14	2.63±0.14	2.28±0.09	2.34±0.07

Legend: Values in the same row with different letters differ significantly (P < 0.05)

The least square means of the rabbit growth traits influenced by the feeding regime are presented in Table 6. Significant differences (P < 0.05) were recorded in the average feed intake and body weight of the rabbits at 7-11 weeks post-weaning and the average weight gain at 11 weeks post-weaning. In all the weeks considered, the *ad libitum* concentrate + *ad libitum* forage feeding regime produced the highest rabbit growth trait values (except at 7 and 11weeks post-weaning whenthe body weight and weight gain of the rabbits were the highest, respectively). However, the rabbits fed 30% restricted concentrate + *ad libitum* forage were found to have higher growth trait values than those fed *ad libitum* concentrate + 30% restricted forage and 30% restricted concentrate + 30% restricted forage.

Table 6. Least square means of the growth traits of the rabbit crosses as influenced by the feeding regime at post-weaning stages (7-11 weeks)

Age(weeks)	Trait	Feed regime			
		A	B	C	D
7	AFI (g)	446.50±16.08[a]	388.12±15.99[c]	417.62±16.91[b]	405.87±14.90[bc]
	BW (g)	739.75±12.27[c]	765.62±12.44[ab]	781.25±7.83[a]	757.29±11.98[b]
	WG (g)	119.37±6.38	100.00±6.68	112.50±6.68	108.33±8.09
	FCR	3.82±0.27	3.97±0.27	3.77±0.21	3.92±0.39
8	AFI (g)	452.87±15.52[a]	395.75±16.16[c]	424.50±16.86[b]	412.75±15.27[bc]
	BW (g)	906.25±11.32[a]	878.12±9.95[ab]	896.87±7.37[ab]	862.50±12.44[b]
	WG (g)	112.50±6.68	112.50±6.68	115.62±4.57	105.20±8.18
	FCR	3.98±0.22	3.76±0.36	3.70±0.19	4.01±0.29
9	AFI (g)	458.25±15.72[a]	400.87±15.69[b]	456.00±13.34[a]	416.91±15.27[b]
	BW (g)	1043.75±20.99[a]	1000.00±11.57[ab]	1000.00±14.17[ab]	976.04±23.35[b]
	WG (g)	137.50±14.17	109.37±9.37	103.12±9.95	111.45±11.51
	FCR	3.53±0.33	3.88±0.42	4.68±0.43	4.04±0.45
10	AFI (g)	463.75±15.78[a]	407.12±15.79[c]	437.37±16.67[b]	421.79±15.54[bc]
	BW (g)	1203.12±15.26[a]	1118.75±20.45[b]	1140.62±6.58[b]	1103.12±24.88[b]
	WG (g)	159.37±10.49[a]	131.25±9.15[b]	140.62±6.58[ab]	127.08±5.66[b]
	FCR	3.02±0.27	3.19±0.22	3.19±0.27	3.34±0.19
11	AFI (g)	471.37±16.23[a]	428.00±6.66[b]	432.00±14.70[b]	430.16±14.52[b]
	BW (g)	1412.50±15.66[a]	1303.12±19.72[bc]	1331.25±13.97[b]	1273.95±25.33[c]
	WG (g)	212.508.18[a]	171.87±7.38[b]	190.62±6.58[ab]	170.83±6.68[b]
	FCR	2.24±0.12	2.52±0.11	2.28±0.09	2.54±0.14

Legend: Values in the same row with different letters differ significantly (P < 0.05); A = *Ad libitum* concentrate + *Ad libitum* forage; B = *Ad libitum* concentrate + 30% restricted forage; C = 30% restricted concentrate + *Ad libitum* forage; D = 30% restricted concentrate + 30% restricted forage

Significant reductions in the feed intake of rabbits caused by the interaction between their genotype and quantitative feeding regimes were also reported by Szendrõ et al. (2008). However, the timing and quantitative feed restriction regimes in rabbits studied by Tumova et al. (2002) did not lead to a significant decrease in feed intake. This indicates that the method of feed restriction, rabbit breeds or crosses, and the age of rabbits can account for differences in the feed intake results obtained in a number ofrabbit feed restriction studies. The lower feed intakes recorded in the Chinchilla and New Zealand White purebreds at 7, 8 and 10 weeks post-weaning suggest that restricted feeding may be more beneficial at a younger age of growing rabbits. Therefore, the costs of feeding can be reduced by introducing growing Chinchilla and New Zealand White purebred rabbits to the 30% restricted concentrate + *ad libitum* forage and *ad libitum* concentrate + 30% restricted forage feeding regimes, respectively.

As the genotype and feeding regimes significantly decreased the rabbit feed intake, no compensatory effect was recorded on the body weight, weight gain and feed conversion ratio of the rabbits at any age, indicating that any genotype can be fed with any of the feeding regimes considered without a negative impact on the growth of rabbits. This result is partly consistent with that of Bergaoui et al. (2008), who studied restrictively (700 and 950 g/kg of free feed intake) and fully fed rabbits aged 35 to 77 days. They observed that non-restricted animals had higher body weight throughout the experimental period, but at 11 weeks of age, there was no difference in daily weight gain, daily feed intake and feed conversion between the two groups. The numerically higher mean growth values obtained in the *ad libitum* fed purebred Chinchilla and New Zealand rabbits is in agreement with the findings of Yassein et al. (2011), who reported that rabbits fed *ad libitum* during the restriction period (28-49 day of age) exhibited a significantly superior growth performance than the restricted group.

Combining restricted feeding with different rabbit genotypes may not improve the growth of rabbits since higher body weight, weight gain and better feed conversion ratio were obtained during *ad libitum* feeding. It is also noted that the Chinchilla and New Zealand weaner rabbit genotypes may do well when fed 30% restricted concentrate + *ad libitum* forage, suggesting that forage is indispensable for the growth and wellbeing of rabbits (Iyeghe-Erakporeobor, 2007; Shilpashree et al., 2016).

CONCLUSION

The interactions between the pure Chinchilla breed and the 30% restricted concentrate + *ad libitum* forage feeding regime and between the pure New Zealand White and the *ad libitum* forage + 30% restricted concentrate significantly reduced the feed intake of the rabbits considered. As the genotype and feeding regimes significantly decreased the rabbit feed intake, no compensatory effect was recorded on the body weight, weight gain and feed conversion ratio of the rabbits at any age, indicating that any genotype can be fed with any of the feeding regimes considered without a negative impact on the growth of rabbits. With regard to the effect of the rabbit genotype alone, the purebred New Zealand rabbits consumed the smallest amount of feed, thus should be considered for minimizing feed costs in rabbit production. The Chinchilla pure cross was found to gain a higher body weight than other genotypes considered, whereas the *ad libitum* concentrate + 30% restricted forage feeding will reduce the feed intake of grower rabbits.

Conflict of interest: The authors declare that they have no conflict of interest.

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