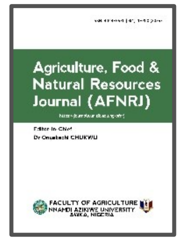
Agr. Foo. Nat. Res. J. Volume 4, Issue 2, Page 1-8

e-ISSN: 1597-7153 | p-ISSN: 3043-5420

Agriculture, Food and Natural Resources Journal

The Official Journal of the Faculty of Agriculture, Nnamdi Azikiwe University, Awka, Nigeria

Journal homepage: https://journals.unizik.edu.ng/afnrj



Original Article

Genotype and energy level interaction effects on post-weaning production performance, morphometric traits and economic indices of rabbits

OPEN ACCESS

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DOI: https://www.doi.org/10.5281/zenodo.17208693

Editor: *Dr Onyekachi Chukwu, Nnamdi Azikiwe University, NIGERIA*

Received: *March 16, 2025*
Accepted: *August 20, 2025*
Available online: *September 30, 2025*

Peer-review: *Externally peer-reviewed*

Conflict of Interest: *The authors have no conflicts of interest to declare*

Financial Disclosure: *The authors declared that this study has received no financial support.*

ABSTRACT

This study evaluated the effects of two rabbit genotypes of Chinchilla (CH×CH; n = 18) and New Zealand White (NZW×NZW; n = 10) and two dietary energy levels (2800 kcal ME/kg [E1] and 3000 kcal ME/kg [E2]) on post-weaning production performance, morphometric traits, and economic indices. A 2 × 2 factorial experiment was implemented using two genotypes (CH×CH and NZW×NZW) and two dietary energy levels (E1 and E2) with three replications in a completely randomized design. Analysis of variance indicated significantly (p < 0.05) higher initial body weight (IBWT) (388.90 ± 3.99 cm), final head-to-shoulder length (FHTSL) (11.43 ± 0.26 cm), and final hind leg length (FLHL) (16.10 ± 9.10 cm) in favour of the interaction between the NZW×NZW genotype and the E2 diet. The NZW×NZW genotype in comparison with the CH×CH, exhibited significantly (p < 0.05) higher IBWT (377.63 g vs. 239.35 g), final body weight (742.42 g vs. 416.73 g), total weight gain (364.79 g vs. 177.38 g), average daily feed intake (13.03 g vs. 7.16 g), and several morphometric traits. The NZW×NZW genotype also significantly (p < 0.05) outperformed the CH×CH in revenue (₦1635.77 vs. ₦740.85) and gross margin (₦1424.65 vs. ₦820.45). Whereas the E2 diet resulted in significantly higher IBWT, the energy level had no significant effect (p > 0.05) on the economic indices. The interaction of NZW×NZW genotype and E2 energy level diet was most effective in enhancing production performance, conformation traits and economic returns, and is recommended for profitable rabbit production.

KEYWORDS: *Dietary energy, Economic measures, Genotype, Growth indicators, Oryctolagus cuniculus*

INTRODUCTION

Rabbit (*Oryctolagus cuniculus*) production offers a sustainable and cost-effective source of high-quality animal protein for human consumption. Unlike pigs and snails, rabbits face minimal religious or cultural dietary restrictions (Mailafia *et al*., 2010; Goli et al., 2025). Their quiet nature and minimal space requirements make them ideal for small-scale and urban farming. Although rabbits naturally consume forages such as *Centrosema pubescens, Tridax procumbens, Aspilia africana, Gliricidia sepium, and Calopogonium mucunoides*, the inclusion of concentrate feeds is essential for intensive and profitable commercial production (Adeyemo *et al*., 2013; Ndzi *et al*., 2023). Additionally, rabbit meat contains less cholesterol than chicken, pork, or beef, making it a suitable protein source for individuals of all ages, especially those with cardiovascular conditions (Petrescu & Petrescu-Mag, 2018).

Among the available breeds in Nigeria, Chinchilla and New Zealand White rabbits are commonly used for research and production (Isaac *et al.*, 2022). While several studies have explored the post-weaning production performance and linear body or conformation traits of these breeds (Chineke, 2005; Assan, 2015; Isaac *et al.*, 2022), limited attention has been

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given to the interactive effects of genotype and dietary energy levels on these parameters. For instance, Anya *et al.* (2011) investigated the effects of varying energy and protein levels on the performance of weaned crossbred New Zealand White and Chinchilla rabbits, while Momoh *et al*. (2015) evaluated the production performance of two crossbred rabbit genotypes fed diets with different protein levels. Additionally, the use of commercial poultry feed in rabbit production is a widespread practice among breeders (Paul & Lallo, 2014; Onukwru *et al*., 2022). Given the established principle that animals cannot fully express their genetic potential without favorable environmental interactions (Onyiro *et al*., 2008; Isaac *et al*., 2022), the inclusion of dietary energy considerations is essential in rabbit genetic improvement programs. Combining genotype and dietary energy level in experimental designs offers the dual benefit of optimizing resource use such as time and space, while enhancing production outcomes (Isaac & Oriaku, 2023).

Therefore, this study aimed to evaluate the main and interaction effects of genotype and dietary energy level on the post-weaning production performance, morphometric traits, and economic indices in rabbits.

MATERIALS AND METHODS

Experimental Location

The study was conducted at the Teaching and Research Farm of the Department of Animal Science, Faculty of Agriculture, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria. The location lies at Latitude 6°24′ N and 7°25′ E in the Souteast tropical rainforest of Nigeria. The minimum and maximum daily temperatures of the area fall between 27°C and 34°C.

Management of Experimental Rabbits

The study utilized twelve clinically healthy and sexually mature rabbits, comprising six Chinchilla and six New Zealand White parents. Each breed group included two bucks and four does. To ensure good health and disease prevention, each rabbit received a subcutaneous injection of 0.2 ml of Ivomectin for ectoparasite control and 0.4 ml intramuscular Oxytetracycline to guard against bacterial infections. Following kindling, does were also given intramuscular injections of Strentopen Viscoplex-Forte (a vitamin-mineral premix) to prevent mastitis.

The rabbits were housed in a well-ventilated pen containing two rows of hutches, each with three tiers. Every hutch held 15 cages, arranged with five cages per tier. The cages were constructed from wood and wire mesh, each measured 50 × 50 × 50 cm³ and accommodated one rabbit.

All parent rabbits were fed commercial broiler concentrate containing 2300 kcal ME/kg and 15% crude protein. This diet was supplemented with a mix of *Centrosema pubescens*, *Tridax procumbens, Aspilia africana,* and *Chromolaena odorata*. Clean water and feed were provided *ad libitum*.

The mating ratio used for the rabbits was one buck to two does. Pregnancy detection was carried out via abdominal palpation 14 days post coitus. Does found not to be pregnant were re-mated. Kindling boxes measuring 35 × 27 × 22 cm³ and filled with bedding materials were provided to the expectant does a few days before kindling. Kindling occurred after a gestation period of 31 days. At birth, a total of eighteen Chinchilla (CH×CH) kits and ten New Zealand White (NZW×NZW) kits were recorded. To prevent maternal rejection, all kits were handled using disposable gloves. They were fed on their dams' milk and also allowed to nibble on the same forages consumed by their dams until weaning at five weeks of age when experimental diets were introduced to them. The management practices adopted here were in line with previous recommendations (Onyiro *et al*., 2008; Isaac *et al*., 2022).

Preparation of feed materials and formulation of experimental diets

The feed ingredients used in the diet formulation included maize grain, cassava root meal, soybean meal, *Centrosema pubescens*, wheat offal, bone meal, and salt. Maize grains were sun-dried and ground, while cassava roots were harvested, peeled, washed, sliced, sun-dried, and ground into cassava meal. *Centrosema pubescens* was collected from the field, shade-dried until crispy, and then ground using a mortar. Soybean meal, wheat offal, and bone meal were sourced from the market. All ingredients were thoroughly dried, ground, milled, and uniformly mixed.

Two experimental diets with different energy levels were formulated for the 4-week study: E1, providing 2800 kilocalories of metabolizable energy per kilogram of feed (kcal ME/kg), and E2, providing 3000 kcal ME/kg. The composition of these diets is detailed in Table 1.

Table 1. Composition of the experimental diets

Ingredients	Percentage composition (%)	
	Diet 1	Diet 2
Maize	23	23
Cassava peel meal	12.5	16.5
Soybean meal	10	12
Centrosema pubescens	21	20
Wheat offal	30	25
Bone meal	3	3
Salt	0.5	0.5
Total	100	100
Energy (kcal ME/kg)	2800	3000
Crude protein (%)	16	16

Experimental design

After weaning, the rabbits were randomly selected from each genotype and allocated to each diet in a completely randomised design (CRD). The experiment was replicated thrice. Two factors were considered: genotype and dietary energy, each at two levels. The statistical model (Equation 1) for the design is as follows:

$$Y_{ijk} = \mu + G_i + E_j + I_{ij} + \varepsilon_{ijk} \quad (1)$$

where, Y_{ijk} is single observation made on a rabbit belonging to one genotype fed one energy level, μ is overall mean, G_i is main effect of genotype (i = 1, 2), E_j is main effect of energy level (j = 1, 2), I_{ij} is interaction effect of genotype and energy level, ε_{ijk} is random error.

Data collection and measurement of parameters

All data were collected for a period of four weeks spanning from 5 to 8 weeks. The parameters were grouped as follows.

Production parameters

Total feed intake (TFI). This was calculated as the total quantity of feed consumed by all the rabbits per treatment combination for the four weeks period.

Average daily feed intake (ADFI). It was computed as the total feed intake divided by the product of the number of animals per treatment combination and number of days for the experiment.

Initial body weight (IBWT). This was the average body weight of rabbits in each treatment combination at 5 weeks of age.

Final Body Weight (FBWT). This was the weight of all rabbits in a given treatment combination at 8 weeks.

Total Weight Gain (TWTG). Total Weight gain was obtained by the difference between the final weight and the initial weight.

Average Daily Weight Gain (ADWTG). This was obtained as total weight gain divided by the product of the number of rabbits per treatment combination and number of days of experiment.

Feed Conversion Ratio (FCR). This was computed as average daily feed intake divided by average daily weight gain.

Morphometric traits

Initial and final measurements of the following morphometric traits were taken in centimeters (cm) at 5 and 8 weeks, respectively.

Body length (BL) was measured as the distance from the tip of the nose to the tail base.

Chest girth (CG) was measured as the circumference of the chest region.

Ear length (EL) was taken as the distance from the ear base to the tip of the ear.

Head - to - shoulder length (HHTSL) was measured as the distance from the tip of the head to the point of the attachment of the shoulder.

Length of fore limb (LFL) was taken as the distance from the shoulder blade to the phalanges.

Length of hind limb (LHL) was measured as the distance of the rear leg from the ball and socket joint to the phalanges.

Economic indices

Cost of total feed intake (CTFI). This was computed in naira (₦) as the product of the cost of total quantity of feed formulated and total feed intake divided by total quantity of feed formulated (Equation 2).

CTFI = (Cost of total quantity of feed formulated x Total feed intake)/Total quantity of feed formulated (2)

Cost of average daily feed intake (CADFI). This was calculated as the product of the cost of total feed formulated and average daily feed intake divided by the total quantity of feed formulated (Equation 3).

CADFI = (Cost of total feed formulated x Average daily feed intake)/Total quantity of feed formulated. (3)

Feed cost/kg weight gain (FC/kgWTG): This was calculated as the product of the cost of total feed formulated and total quantity of feed formulated multiplied by feed conversion ratio (Equation 4).

FC/kgWTG = Cost of total feed formulated x Total quantity of feed formulated) x Feed conversion ratio (4)

Revenue (₦) was calculated as Price/kg body weight x mean final body weight, where Price/kg body weight was obtained as average market price of parent rabbits purchased divided by average body weight of parent rabbits purchased.

Gross margin (in terms of feed cost) was obtained in naira as revenue minus cost of total feed intake.

Data analysis

Data were analysed by two-way analysis of variance (ANOVA) using the Multivariate General Linear Model procedure of IBM SPSS Statistics (2011) computer software. The result yielded ANOVA for genotype × energy level interaction, genotype and energy level main effects. Significant genotype × energy level interaction effect was first analysed as a single factor and subsequently separated by Duncan's (1955) Multiple Range Test.

RESULTS AND DISCUSSION

Results

Table 2 presents the mean (± se) production parameters of weaned rabbits as influenced by the genotype × dietary energy level interaction. The NZW×NZW genotype fed diet containing 3000 kcal ME/kg recorded the highest ($p < 0.05$) mean initial body weight (IBWT) of 388.90 g, which was not significantly different from the IBWT of 366.36 g observed in the same genotype fed diet containing 2800 kcal ME/kg. The lowest IBWT was recorded in the CH × CH genotype fed diet containing 2800 kcal ME/kg.

Final body weight (FBWT), average daily weight gain (ADWTG), average daily feed intake (ADFI), and feed conversion ratio (FCR) did not differ significantly ($p > 0.05$) among the genotype × energy level interaction groups. However, the NZW × NZW genotype fed diet containing 3000 kcal ME/kg showed numerically higher values for these parameters compared to the other interaction groups.

Table 2. Mean (± se) production parameters e of weaned rabbits influenced by genotype × energy level interaction at 5-8 weeks

Parameter	CH×CH		NZW×NZW		P-value
	2800 (kcal ME/kg)	3000 (kcal ME/kg)	2800 (kcal ME/kg)	3000 (kcal ME/kg)	
TFI (g)	1445.46ᵃ ± 88.51	523.11ᶜ±78.00	973.70ᵇ±6.63	1092.27ᵇ±15.26	0.000
ADFI (g)	20.33 ±1.89	21.26±4.68	34.70±0.03	37.74±0.29	0.688
IBWT (g)	188.29ᶜ ±6.07	290.40ᵇ±22.24	366.36ᵃ±0.51	388.90ᵃ ±3.99	0.009
FBWT (g)	370.24±7.25	463.21±46.28	735.79±9.60	749.13±0.55	0.135
TWTG (g)	181.95±3.72	172.81±24.04	369.34±9.10	360.23±3.61	0.999
ADWTG (g)	6.99±039	7.34±1.62	13.19±0.33	12.87±0.13	0.703
FCR	2.90±0.11	2.90±0.05	2.63±0.07	2.70±0.20	0.811

[a, b]Means within the same row with different superscripts differed significantly (p<0.05). TFI = Total feed intake, ADFI = Average daily feed intake, IBWT = Initial body weight, FBWT = Final body weight, TWG = Total weight gain, ADWG = Average daily weight gain, FCqR = Feed conversion ratio

Table 3 shows the main effects of genotype and dietary energy level on the production parameters of weaned rabbits. The NZW×NZW genotype exhibited significantly better growth (p<0.05) than the CH×CH genotype. Additionally, rabbits fed a diet with 3000 kcal ME/kg had a significantly higher initial body weight (IBWT) of 339.65 g compared to 277.30 g for those fed 2800 kcal ME/kg (p<0.05). No significant differences were observed between the two energy levels for the other production parameters.

In Table 4, the genotype × energy level interaction effect did not significantly (p > 0.05) increase most of the morphometric traits except for mean final HTSL, LHL and TL. The highest means for these traits were obtained from the interaction between NZW×NZW and 3000 kcal ME/kg while the least in each case was from the interaction between CH×CH and 2800 kcal ME/kg. The mean final HTSL obtained from the interaction between NZW×NZW and 2800 kcal ME/kg although smaller, did not differ significantly (p>0.05) from the interaction between NZW×NZW and 3000 kcal ME/kg. The interaction between NZW×NZW and 3000 kcal ME/kg also gave higher numerical mean values for most of the traits that did not differ significantly.

Table 5 presents the main effects of genotype and energy level on the morphometric traits. The results indicated significant difference (p < 0. 05) between the two genotypes in most of the morphometric traits except for initial LFL and FEL which were not significant (p>0.05). The energy levels did not impact any significant difference (p>0.05) in the traits measured. The mean morphometric traits of NZW×NZW were all higher than those of the CH×CH genotype.

The result of Table 6 indicated no significant difference in the economics of production indices among the genotype × energy level interactions. However, the least CTFI and CADFI were obtained from the interaction between CH×CH and diet containing 2800 kcal ME/kg. The interaction between NZW×NZW and 3000 kcal ME/kg gave higher numerical revenue and gross margin than other interactions. The feed cost/kg weight gain (₦ 551.88±40.90) obtained from the interaction between NZW×NZW and 3000 kcal ME/kg was closer to the least cost/kg weight gain (₦ 538.25±10.04) obtained from the interaction between CH×CH and 3000 kcal ME/kg.

Table 7 presents the main effects of genotype and energy level on the economics of production indices of the rabbits. The results indicated significant differences in some of the indices. In both Tables, CH×CH genotype and 2800 kcal ME/kg main effects gave the least CTFI and CADFI while NZW×NZW genotype and 3000 kcal ME/kg diet gave the highest amount of revenue. For GM, NZW×NZW and 2800 kcal ME/ kg main effects recorded the highest significant amounts.

Table 3. Mean (± se) production parameters of weaned rabbits influenced by genotype and energy level main effects at 5-8 weeks

Parameter	Genotype		P-value
	CH×CH	NZW×NZW	
TFI (g)	984.28 ±212.88	1032.99±27.54	0.437
ADFI (g)	20.80ᵇ ±2.27	36.22ᵃ ±070	0.000
IBWT(g)	239.35ᵇ ±25.65	377.63ᵃ ±5.35	0.000
FBWT(g)	416.73ᵇ±29.51	742.42ᵃ ±5.25	0.000
TWTG(g)	177.38ᵇ±11.07	364.79ᵃ ±4.83	0.000
ADWTG(g)	7.16ᵇ±0.75	13.03ᵃ ±0.17	0.000
FCR	2.90±0.05	2.67 ±0.10	0.091
Parameter	**Energy level (kcal ME/kg)**		**P-value**
	2800	**3000**	
TFI (g)	1209.58ᵃ±112.72	807.68ᵇ ±132.14	0.000
ADFI (g)	27.52 ±3.33	29.50 ±4.24	0.456
IBWT(g)	277.32ᵇ±39.91	339.65ᵃ ±24.23	0.001
FBWT(g)	552.97±81.90	606.17±67.24	0.057
TWTG(g)	275.65±42.13	266.52±43.30	0.506
ADWTG(g)	10.09±1.41	10.10±1.44	0.988
FCR	2.77±0.08	2.80±0.10	0.770

[a, b]Means within the same row with different superscripts differed significantly (p<0.05). TFI = Total feed intake, ADFI = Average daily feed intake, IBWT = Initial body weight, FBWT = Final body weight, TWG = Total weight gain, ADWG = Average daily weight gain, FCR = Feed conversion ratio

Table 4. Mean (± se) initial and final morphometric traits of weaned rabbits influenced by genotype × energy level interaction at 5 and 8 weeks

	CH×CH		NZW×NZW		P-value
*Parameter (cm)	2800 (kcal ME/kg)	3000 (kcal ME/kg)	2800 (kcal ME/kg)	3000 (kcal ME/kg)	
IBL	21.00 ±0.58	24.00±3.51	29.00±0.0	29.33±0.67	0.621
ICG	16.67±0.33	17.83±1.92	21.57±30	21.87±+0.30	0.482
IEL	6.47±0.13	6.53±0.53	8.57±0.20	8.57±0.18	0.916
IHTSL	7.53±0.15	7.87±0.82	10.30±0.17	10.03±0.09	0.501
ILFL	7.70±0.20	8.30±1.10	8.30±0.12	8.60±0.06	0.797
ILHL	10.33±0.57	10.13±0.93	14.57±0.07	14.50±0.29	0.909
ITL	5.83±0.17	5.90±0.40	7.03±0.03	7.33±0.35	0.688
FBL	26.87±0.47	26.97±0.54	34.03±26	34.97±0.49	0.383
FCG	20.33±0.67	20.33±0.60	24.93±0.47	26.60±0.31	0.154
FEL	7.60±0.46	32.17±23.92	9.80±0.40	10.10±0.21	0.340
FHTSL	8.73^{b} ±0.55	7.57^{c} ±0.22	10.63^{a} ±0.23	11.43^{a} ±0.26	0.022
FLFL	8.67±0.43	6.50±3.25	11.70±0.44	12.40±0.21	0.382
FLHL	12.27^{c} 0.30	11.67^{c} ±0.48	14.97^{b} ±0.37	16.10^{a} ±9.10	0.035
FTL	7.40^{c} ±0.26	8.23^{b} ±0.15	8.10^{b} ±0.17	10.17^{a} ±0.09	0.009

$^{a, b}$Means within the same row with different superscripts differed significantly (p<0.05). *I or F starting an abbreviation stands for initial or final. BL = Body length, CG =Chest girth, EL = Ear length, HTSL = Head-to-shoulder length, LFL = Length of fore limb, LHL Length of hind limb, TL =Tail length

Table 5. Mean (±se) initial and final morphometric traits of weaned rabbits influenced by genotype and energy level main effects at 5 and 8 weeks

	Genotype main effect					
	Initial		P-value	Final		P-value
Parameter	CH×CH	NZW×NZW		CHxCH	NZWxNZW	
BL	22.50^{b} ± 1.73	29.17^{a} ± 0.31	0.006	26.92^{b} ± 0.32	34.50^{a} ± 0.32	0.000
CG	17.25^{b} ± 0.91	21.72^{a} ± 0.20	0.002	20.33^{b} ± 0.46	25.77^{a} ± 0.45	0.000
EL	6.50^{b} ± 0.25	8.57^{a} ± 0.12	0.000	19.88 ± 12.03	9.95 ± 0.21	0.430
HTSL	7.70^{b} ± 0.38	10.17^{a} ± 0.11	0.000	8.15^{b} ± 0.37	11.03^{a} ± 0.24	0.000
LFL	8.00 ± 0.52	8.45 ± 0.09	0.447	7.68^{b} ± 1.56	12.03^{a} ± 0.27	0.030
LHL	10.23^{b} ± 0.49	14.53^{a} ± 0.13	0.000	11.97^{b} ± 0.29	15.53^{a} ± 0.31	0.000
TL	5.87^{b} ± 0.19	7.18^{a} ± 0.17	0.002	7.82^{b} ± 0.23	9.13^{a} ± 0.47	0.000
	Energy level (kcal ME/kg) main effect					
	Initial		P-value	Final		P-value
Parameter	2800	3000		2800	3000	
BL	25.00 ± 1.81	26.67 ± 1.20	0.384	30.45 ± 1.62	30.97 ± 1.82	0.285
CG	19.12 ± 1.11	19.85 ± 1.25	0.483	22.63 ± 1.09	23.47 ± 1.43	0.154
ELl	7.52 ± 0.48	7.55 ± 0.52	0.916	8.70 ± 0.56	21.13 ± 1.78	0.329
HTSL	8.92 ± 0.63	8.95 ± 0.61	0.940	9.68 ± 0.50	9.50 ± 0.88	0.610
LFL	8.00 + 0.17	8.45 ± 0.50	0.447	10.28 ± 0.69	9.45 ± 1.97	0.629
LHL	12.45 ± 0.99	12.32 ± 1.07	0.820	13.62 ± 0.64	13.88 ± 1.02	0.457
TL	6.43 ± 0.28	6.62 ± 0.40	0.531	7.75^{b} ± 0.21	9.20^{a} ± 0.44	0.000

$^{a, b}$Means within the same row with different superscripts differed significantly different (p<0.05). BL = Body length, CG = Chest girth, EL = Ear length, HTSL = Head-to-shoulder length, LFL = Length of fore limb, LHL Length of hind limb, TL =Tail length

Table 6. Mean (± se) indices of economic production of weaned rabbits influenced by genotype × energy level interaction at 5-8 weeks

Indices (₦)	CH×CH		NZW×NZW		P-value
	2800 (kcal ME/kg)	3000 (kcal ME/kg)	2800 (kcal ME/kg)	3000 (kcal ME/kg)	
CTFI	52.29±22.67	106.92±15.94	198.99±1.37	223.26±3.12	0.308
CADFI	1.87±0.81	3.82±0.57	7.11±0.05	7.97±0.11	0.308
Feed cost/kg WTG	592.08±22.46	538.25±10.04	593.44±13.63	551.88±40.90	0.811
Revenue	815.66±15.97	825.25±264.60	1620.79±21.17	1650.76±0.89	0. 941
Gross margin	763.37±38.15	718.32±252.40	1421.80±20.64	1427.50±2.90	0.848

CTFI = Cost of total feed intake, CADFI = Cost of average daily feed intake, WTG = Weight gain

Table 7. Mean (± se) indices of economic production of weaned rabbits influenced by genotype and energy level main effects at 5-8 weeks

Indices (₦)	Genotype		P-value
	CH×CH	NZW×NZW	
CTFI	79.61^{b}±17.40	211.13^{a}±5.64	0.000
CADFI	2.84^{b}±0.62	7.54^{a}±0.20	0.000
Feed cost/kg WTG	592.76±11.01	545.07±19.52	0.091
Revenue	820.45^{b}±118.57	1635.77^{a}±11.60	0.000
Gross Margin	740.85^{b}±114.60	1424.65^{a}±9.41	0.001
Indices (₦)	**Energy level (kcal ME/kg)**		**P-value**
	2800	**3000**	
CTFI	125.64±34.34	165.09±27.01	0.000
CADFI	4.45±1.23	5.90±0.96	0.000
Feed cost/kg WTG	565.17±16.82	572.66±21.00	0.770
Revenue	1218.23±180.42	1238.06±219.26	0.000
Gross Margin	1092.59±148.50	1072.91±194.65	0.001

CTFI = Cost of total feed intake, CADFI = Cost of average daily feed intake, WTG = Weight gain

DISCUSSION

The higher initial body weight recorded at five weeks in New Zealand White rabbits fed a diet containing 3000 kcal ME/kg suggests that this genotype possesses superior genetic potential, allowing for a more favorable response to the diet and resulting in improved post-weaning body weight. This observation aligns with the findings of Olufowobi *et al.* (2015), who reported that New Zealand White rabbits demonstrated higher body weights compared to Chinchilla rabbits. Furthermore, the superior production performance and the morphometric traits observed in the New Zealand White rabbits, relative to the Chinchilla rabbits, further support the notion that New Zealand White rabbits have greater genetic potential for enhanced growth rate, body size, and overall conformation. These traits confer a competitive advantage for the improvement of body size and meat production traits in this breed. This assertion is consistent with the reports of Yakubu *et al.* (2009) and Nwaogwugwu *et al.* (2018), who emphasized the importance of body size and conformation as valuable attributes for the improvement of growth traits in meat animals.

Conversely, Kabir *et al.* (2018) reported higher body weight and certain linear body traits in Chinchilla rabbits compared to New Zealand White rabbits when fed a diet containing 16% crude protein and 2504 kcal ME/kg between 6 and 14 weeks of age. Similarly, Onyiro *et al.* (2008) found that purebred Chinchilla rabbits outperformed other genotypes, including New Zealand White crosses, in growth traits under restricted feeding conditions. These contrasting findings may be attributed to variations in weaning age and environmental factors across the studies, both of which are well-documented influences on rabbit production performance (Obike *et al.*, 2014; Ragab *et al.*, 2021).

In the present study, the absence of a significant difference in ear length between the two genotypes agrees with the findings of Oke *et al.* (2004) for Chinchilla and Dutch rabbit breeds, and with those of Sam *et al.* (2020), who observed no significant variation in ear length among purebred Chinchilla, New Zealand White, and their reciprocal crossbreds at 4, 6, and 10 weeks of age. This consistency suggests that both breeds may share similar genes for ear length, indicating that this trait may not serve as a reliable biometric marker for breed characterization or selection. This view is further supported by Isaac and Oriaku (2023), who found uniform ear length growth across genotype × feeding regime interactions, suggesting low genetic variability for this trait.

The combination of the CH×CH genotype and the 2800 kcal ME/kg diet resulted in the lowest total and average daily feed intake, which did not translate into higher revenue. This is evident from the higher feed cost per kilogram weight gain (Table 6), increased average daily feed intake (ADFI), and reduced average daily weight gain (ADWTG) shown in Table 2 when compared with other treatment groups. Although the cost of total feed intake for CH×CH rabbits fed 2800 and 3000 kcal ME/kg diets was lower than the ₦90.96 – ₦163.89 range reported by Adeyemo *et al.* (2013) for rabbits fed mixed forage and concentrate diets, profitability was not guaranteed. On the other hand, the higher revenue from the NZW x NZW genotype fed 3000 kcal ME/kg diet, and the lowest feed cost per kilogram weight gain recorded for CH×CH on the same diet, suggest that optimal combinations of genotype and energy level can enhance profitability. This supports the findings by Lebas and Renard (2006). Weight gain is a critical performance indicator in meat production, as it influences market value more reliably than body weight, since smaller animals may gain weight more efficiently than larger ones over the same period.

Feed cost per weight gain for the 2800 and 3000 kcal ME/kg diets was ₦592.76±11.01 and ₦545.07±19.52, respectively. These figures are comparable to the ₦471.58 reported by Anya *et al*. (2011) for NZW×CH rabbits fed a 3410 kcal ME/kg diet. Despite time differences and possible inflation of feed costs, this study remains economically relevant. Finally, the higher gross margin associated with the NZW×NZW genotype indicates that New Zealand White rabbits were more profitable than the Chinchilla breed under the same dietary conditions. In general, both the main and interaction effects of the New Zealand White genotype and the 3000 kcal ME/kg diet significantly improved production performance and profitability in the rabbit production.

CONCLUSION AND RECOMMENDATIONS

This study demonstrates that the interaction between the New Zealand White rabbit genotype and a dietary energy level of 3000 kcal ME/kg significantly enhanced the production parameters and the morphometric traits, particularly in terms of initial body weight, final head-to-shoulder length, and hind limb length during the post-weaning phase (5–8 weeks). This combination consistently outperformed other genotype × diet interactions across most linear body measurements and economic indices. While the New Zealand White rabbits on the 2800 kcal ME/kg diet showed comparability in initial body weight, the 3000 kcal ME/kg diet was superior overall. As independent factors, both the New Zealand White genotype and the 3000 kcal ME/kg diet yielded the most favorable outcomes. These findings underscore the synergistic advantage of this genotype × diet interaction and support its recommendation for optimizing growth performance, enhancing body conformation, and maximizing economic returns in commercial rabbit production systems.

Acknowledgement: The authors are grateful to the Department of Animal Science, Nnamdi Azikiwe University, Awka for providing enabling environment to carry out this research.

Author Contributions:

UCI, AAO, FAO & GMO managed data collection, interpretation of data, UCI managed writing of manuscript, material support, and review of manuscripts and wrote the first draft of the manuscript. UCI managed the literature searches. UCI & LCU managed the development of methodology, UCI managed data analysis, and the development of the model. All authors read and approved the final manuscript.

Ethical Statement

The animals were handled with care without inflicting injury on them.

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