EFFECT OF GENOTYPE ON GROWTH AND MORPHOMETRIC TRAITS OF TROPICALLY ADAPTED PURE AND CROSS BRED EXOTIC RABBIT

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ABSRACT

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Three extant breeds of tropically adapted exotic rabbits (California white; CW, Chinchilla; CH and New Zealand red; NZR) were used to generate both pure and crossbred genotypes via random mating design. Both pure and crossbred of six genotypes of exotic rabbit; CW x CW, NZR x NZR, CH x CH, NZR x CH, CH x CW, CH x NZR were generated using random mating design to obtain one hundred and thirty eighty kittens(138) at 23 animals per genetic group to examine the influence of breed on growth performance. Body weight and morphometric traits were recorded early in the morning before feeding on weekly basis commencing from pre-weaning age (21th day) till the post weaning age (84th day) i.e. weeks 3, 6, 9, and 12. The following morphometric traits were measured; ear length, breast girth, height at withers, tail length, trotter length and body length. At week 12, genotype exerted significant influence ($p<0.05$) on body weight and other morphometric traits examined with cross bred NZR x CH genotype showing a superior performance on ear length, breast girth, and body length with pure bred NZR x NZR genotype showing supremacy in body weight and trotter length, thus implying a bigger size advantage over its contemporaries. Across genotypes, sexual dimorphism evidently ($p<0.05$) influenced body weight with bucks showing supremacy in body weight indicating that bucks are bigger and heavier than the does. Across all weeks, positively high ($p<0.01$) and significant ($p<0.05$) relationships were established between body weight and other morphometric traits examined. Therefore, pure and crossbred exotic rabbits are genetically beneficial with bucks showing bigger size advantage relative to does for increased meat yield and that the significant correlations between body weight and some selected body measurements e.g. body length, trotter length, ear length, breast girth, height at withers inform that these traits could be used in breed selection, improvement and morphometric traits prediction programs.

***Keywords**: Rabbit, genotypes, breed, morphometric traits, sex*

INTRODUCTION

Growth in animals is a function of time, nutrition, breed, husbandry system, health management practices among other variables and animals of different ages have different live weight which provides reliable and informative measure of selection (Thiruvenkander, 2005). Body weight of live animals is the most reliable measure of growth performance, the significant use of linear body measurement of animals has been emphasized especially in its use in predicting live weight and relationship with other body morphometric traits (Tegbe and Olorunju, 1988; Adewumi *et al*., 2006)

Morphometric traits assessment has also been used as tools for characterization of breeds and evaluation of breed performance base of phenotypic observation (Ozoje and Herbert, 1997). Assessment of morphometric traits have been used to study the effect of crossbreeding as a medium for selecting and replacement of animals (Adewumi *et al.,* 2006). Morphometric traits are excellent factors in meat production prediction since it determines the market value of the animals (Ikeobi and Faleti, 1996). Linear body measurements have been used to describe body conformation, carcass composition, evaluate breed performance, predict live weight gain and examine relationships among morphometric characteristics, reproductive performance with a view to studying the interactions between heredity and the environment in several animals (Monsi 1992; Okon *et al.,* 1997; Chineke 1996; Akpa, 2000; Ozoje and Mbere, 2002). There is dearth of information on the influence of breed difference and genotype of growth performance of tropically adapted pure and cross bred exotic rabbit. Therefore, this research intends to examine the influence of genotype and breed difference on morphometric traits of pure and cross bred rabbit for breed characterization/selection, breed performance, informative production decision making and optimum performance.

MATERIAL AND METHODS

Description of experimental site

This research was conducted at the breeding unit of the Department of Animal Breeding and Genetics Teaching and Research Farm, Federal University of Agriculture Abeokuta, Ogun State, Nigeria (7^{o}10'N and 3°2'E). The research site lies in the humid South–Western part of Nigeria with mean annual rain fall and ambient temperature of 1037 mm and 34.7 °C respectively with relative humidity of 82 and altitude of 72 m above sea level.

Experimental animals and management

The breeder stock (30 does and 6 bucks) was randomly selected from tropically bred exotic flock for generation of pure and cross bred genotypes. Both pure and cross bred of six (6) genotypes of exotic rabbit; California white

(CW x CW), New Zealand red (NZR x NZR), Chinchilla (CH x CH), NZR x CH, CH x CW, CH x NZR were generated using random mating design to obtain one hundred and thirty eighty (138) kittens at 23 animals per genetic group to examine the influence of genotype on growth performance of exotic and pure breed rabbit. The rabbits were housed in raised hutches made of wooden and metallic material with breeding does and bucks housed in an individual cell size of 100 x 60 x 80 cm^3 having wire gauze body and floor for efficient waste management and ventilation. The breeder stock was fed with compounded ration, clean and cool water and greens (*Panicum maximum, Asphillia africana* and *Tridax procumbens* were given at *ad libitum.* All medication and vaccinations were adhered to religiously.

Mating, Kindling and litters management

Six (6) months old does were served with bucks at 6-7 months of age. Mating (1 bucks: 5 does) was carried out early in the morning as does were introduced into the individual bucks' cell for mating. After mating, the does were returned to their individual cells. And this was done for three consecutive days to ensure effective copulation and conception. Between days 10–14 palpating of the abdomen was carried to confirm pregnancy. At day 30, pregnant doe kindled in an already provided fur bedded nesting box. After Kindling, the dead kittens were removed. The healthy kittens in each genotypic group were examined for birth defects and defective kittens were discarded. The kittens were maintained on doe's milk till weaning (42^{th} day/6 weeks). Each weaner was transferred into previously disinfected growers' hutch with each weaner housed in an individual cell till post weaning age (growers' age) at 84^{th} day /12^{th} week/3 months.

Measurement of morphometric traits

Sensitive scale was used in weighing the animals while tape rule was used in recording body linear measurements on weekly basis. Both weight and body linear measurements were recorded early in the morning before feeding on weekly basis commencing from pre-weaning age (21^{th} day per 3 weeks) till the post weaning age per growers' age (84^{th} day per 12 weeks per 3 months), i.e. morphometric measurements were taken at weeks 3, 6, 9, and 12. The following morphometric traits were measured; body weight (BW), ear length (EL), and breast girth (BG), height at withers (HW), tail length (TL), trotter length (TRL) and body length (BL).

Statistical analyses

All data collected were estimated using completely randomized design of SAS version 1999

The linear model employed was*:*

$Y_{ij} = \mu + A_i + B_j + C_{ij} + e_{ij}$

Y_{ij} = trait of interest*;*

μ = population mean*;*

A_i = effect of i^{th} genotype (i^{th}=CW x CW, NZR x NZR, CH x CH, NZR x CH, CH x CW, CH x NZR)

B_j*= effect of* j^{th}*sex (jth= 1-2)*

C_{ij}*= effect of* i^{th} *genotype and* j^{th} *sex interaction*

e_{ij}= random error and all significantly different means were separated using Duncan multiple range test procedure Gomez and Gomez(1984).

RESULTS

Genotype of rabbit significantly ($p<0.05$) influenced body weight and morphometric traits examined at week 3, cross bred CH x CW genotype recorded the highest values of body weight (288.03±11.08 g), ear length (6.62±0.17 cm), trotter length (6.01±0.33 cm) and body length (19.53±0.42 cm) while pure bred NZR x NZR genotype had the highest breast girth value (16.77±0.62 cm) with pure bred CH x CH genotype having the longest tail length (7.04±0.22 cm) and cross bred NZR x CH genotype having the highest value of height at withers (10.48±0.23 cm) as shown in Table 1. Table 2 showed the significant ($p<0.05$) effect of genotype on body weight and morphometric traits considered at week 6, pure bred CW x CW genotype had the highest body weight and trotter length of 433.0±22.24 cm and 7.17±0.72 cm respectively, cross bred NZR x CH genotype recorded highest values for breast girth (19.53±0.33 cm), height at withers (9.13±0.26 cm), tail length (9.03±0.42 cm) and body length (25.5±40.53 cm).

Genotype of rabbit had significant ($p<0.05$) effect on body weight and morphometric traits examined at week 9, highest morphometric values were recorded for body weight in pure bred NZR x NZR (730.00±31.71 g), body length in pure bred CW x CW genotype (30.38±0.96 cm) and tail length in pure bred CH x CH genotype (10.95±0.60 cm) while cross bred NZR x CH genotype recorded highest values for breast girth (26.90±0.68 cm) and height at withers (23.47±0.31 cm) whereas cross bred CW x NZR genotype had the highest trotter length (Table 3). Genotype significantly ($p<0.05$) influenced body weight and morphometric traits considered at week 12, pure bred NZR x NZR genotype had the highest body weight (902.80±37.33 g) and trotter length (16.31±0.38 cm). Pure bred CH x CH genotype had the highest value for tail length (10.45±0.36 cm) and height at withers (24.36±0.30 cm) while the cross bred NZR x CH genotype recorded the highest ear length, breast girth and body length with 10.90±0.20 cm, 26.56±0.76 cm and 35.73±0.63 cm respectively (Table 4).

Sexual dimorphism exerted significant ($p<0.05$) effect body weight of all the pure bred genotype considered with increasing trend in weight gain from week 3 to week 12 with buck having the highest body weight (947.96±31.18 g) relative its doe counterparts (879.08±59.39 g) as shown in Table 5. Also cross bred genotype recorded

significant ($p<0.05$) increasing trend in weight gain from week 3 to week 12 with buck having the highest body weight gain (822.59±29.74 g) relative its doe (677.95±28.31 g) as shown in table in Table 6, while sex dimorphism exerted no significant ($p>0.05$) effect on other morphometric traits examined (Tables 5 and 6).

Table 1: Effect of genotype on body weight and morphometric measurement at week 3

Genotype	Body weight (g)	Ear length (cm)	Breast girth (cm)	Height at withers (cm)	Tail length (cm)	Trotter length (cm)	Body length (cm)
CW x CW	234.04±11.08b	4.32±0.17d	13.86±0.65d	5.57±0.23d	3.78±0.20c	3.00±0.33d	16.73±0.42b
NZR x NZR	176.96±10.60c	4.73±0.16d	16.77±0.62a	5.33±0.22d	3.87±0.26c	3.42±0.19d	12.25±0.31d
CH x CH	181.96±12.35c	5.06±0.19c	13.67±0.72d	8.87±0.26b	7.04±0.22a	5.53±0.37c	15.20±0.47c
NZR x CH	247.83±11.04b	6.13±0.17b	16.01±0.65b	10.48±0.23a	5.01±0.20b	6.73±0.33b	16.35±0.42b
CH x CW	288.03±1108a	6.62±0.17a	15.51±0.65b	6.53±0.23c	5.29±0.20b	6.91±0.33a	19.53±0.42a
CW x NZR	150.54±11.56c	4.8±0.18d	14.15±0.68c	5.40±0.24d	3.41±0.21c	4.40±0.35c	14.54±0.44c

*Means with different alphabets within the same column are significantly different ($p<0.05$)

Table 2 Effect of genotype on body weight and morphometric measurement at week 6

Genotype	Body weight (g)	Ear length (cm)	Breast girth (cm)	Height at withers (cm)	Tail length (cm)	Trotter length (cm)	Body length (cm)
CW x CW	433.20±22.24a	6.84±0.18b	17.59±0.30c	6.76±0.23d	6.78±0.38b	7.17±1.59b	23.52±0.48c
NZR x NZR	375.90±24.04c	7.36±0.19a	18.72±0.32b	7.27±0.25d	6.09±0.41b	8.16±1.72a	24.13±0.52b
CH x CH	392.60±24.39c	7.64±0.20a	16.79±0.33d	8.38±0.26b	8.86+0.42a	7.32±1.74b	18.43±0.53d
NZR x CH	404.90±29.39b	7.34±0.20a	19.53±0.33a	9.13±0.26a	9.03±0.42b	7.69±1.74b	25.54±0.53a
CH x CW	430.70±23.93a	7.49±0.19a	17.53±0.32c	7.28±0.25c	6.09±0.41b	7.89±1.71b	23.32±0.52c
CW x NZR	413.30±24.39b	7.39±0.20a	18.10±0.33b	7.32±0.26c	6.24±0.42b	8.09±1.74a	22.15±0.53c

*Means with different alphabets within the same column are significantly different ($p<0.05$)

Table 3 Effect of genotype on body weight and morphometric measurement at week 9

Genotype	Body weight (g)	Ear length (cm)	Breast girth (cm)	Height at withers (cm)	Tail Length (cm)	Trotter length (cm)	Body length (cm)
CW x CW	675.40±33.71a	8.71±0.18b	22.71±0.74c	19.16±0.34c	10.39±0.58a	10.26±0.96b	30.38±0.96a
NZR x NZR	730.00±31.71a	8.93±0.17b	25.19±0.69b	18.50±0.32c	7.92±0.54c	10.42±0.64b	29.81±0.89b
CH x CH	674.40±12.35a	9.01±0.19a	18.18±0.77d	21.91±0.36b	10.95±0.60a	8.79±0.74c	21.20±0.25d
NZR x CH	620.50±30.75b	9.51±0.17a	26.90±0.68a	23.47±0.31a	8.93±0.53b	9.41±0.65c	29.38±0.88b
CH x CW	609.20±33.80b	8.75±0.18b	21.48±0.74c	18.06±0.35c	7.91±0.58c	10.28±0.71b	28.16±0.96c
CW x NZR	604.50±31.36b	9.04±0.17a	21.97±0.69c	18.62±0.32c	7.88±0.54c	11.36±0.66a	24.61±0.89d

*Means with different alphabets within the same column are significantly different ($p<0.05$)

Table 4 Effect of genotype on body weight and morphometric measurement at week 12

Genotype	Body weight (g)	Ear length (cm)	Breast girth (cm)	Height at withers (cm)	Tail length (cm)	Trotter length (cm)	Body length (cm)
CW x CW	841.8±44.86d	9.56±0.22b	22.04±0.84c	10.07±0.30c	9.84±0.36c	14.20±0.45b	33.47±0.69c
NZR x NZR	902.80±37.33a	9.77±0.18b	25.56±0.70a	10.02±0.25c	9.21±0.30c	16.31±0.38a	34.9±60.58b
CH x CH	862.10±44.86b	9.79±0.22b	20.08±0.84d	24.36±0.30a	10.45±0.36a	9.44±0.45d	24.89±0.69d
NZR x CH	847.00±40.57c	10.90±0.20a	26.56±0.76a	24.06±0.27a	10.66±0.32b	10.90±0.41c	35.73±0.63a
CH x CW	804.20±42.23d	9.90±0.20b	25.66±0.79a	19.56±0.28b	9.60±0.33c	13.85±0.45b	32.42±0.65c
CW x NZR	873.30±42.23b	9.88±0.20b	23.90±0.90b	19.83±0.28b	9.49±0.33c	13.54±0.43b	33.34±0.65c

At week 3, correlation estimation of morphometric traits between pure bred rabbit established a significant ($p<0.05$) relationship between body weight and trotter length ($r = 0.26$), a significant ($p<0.01$) relationship was recorded between ear length and tail length ($r = 0.35$), also ear length recorded a significantly ($p<0.05$) positive association with body length ($r = 0.41$) and height at withers ($r = 0.40$). Breast girth established a positively high ($p<0.01$) correlation with body length ($r = 0.52$) and trotter length ($r = 0.75$). Evidently, a highly positive correlation ($p<0.01$) was established between tail length and height at withers ($r = 0.93$) as shown in Table 7. Similarly at week 3, correlation estimation studies between morphometric traits of cross bred rabbit established a significant ($p<0.01$) relationship between ear length and tail length ($r =0.39$) as well as height at withers ($r = 0.36$). Tail length recorded a highly correlated ($p<0.01$) relationship with body length ($r = 0.66$), trotter length ($r = 0.36$) and height at withers ($r = 0.32$). A positively high ($p<0.01$) association existed between body length and

trotter length (r = 0.43) while trotter length recorded a highly significant (p<0.01) relationship with height at withers (r = 0.46) as shown in Table 8.

Table 5 Effect of sex on morphometric traits of pure bred rabbits

Week	Sex	Ear length (cm)	Breast girth (cm)	Tail length (cm)	Body length (cm)	Trotter length (cm)	Height at withers (cm)	Body weight (g)
3	Male	4.67±0.13a	11.23±0.85a	17.56±0.99a	16.78±0.39a	10.05±0.51a	17.70±0.60a	201.83±7.11e
	Female	4.75±0.11a	12.99±1.48a	17.15±1.08a	16.95±0.36a	10.64±0.57a	17.35±0.58a	200.60±10.69e
6	Male	7.17±0.20a	14.85±1.06a	12.05±1.65a	21.55±0.57a	13.58±0.92a	10.96±1.1a	390.83±14.75e
	Female	7.41±0.19a	15.23±1.04a	11.26±1.65a	22.77±0.65a	10.23±1.02a	10.23±0.97a	413.82±18.80d
9	Male	8.92±0.85a	17.07±1.47a	14.64±2.24a	27.06±0.97a	10.81±1.39a	12.70±1.38a	670.82±23.57c
	Female	8.84±1.55a	17.23±1.57a	15.53±2.15a	27.70±1.14a	10.10±1.65a	12.77±1.41a	713.19±34.28b
12	Male	9.75±0.15a	19.40±1.60a	18.08±2.98a	31.17±1.0a	10.74±1.76a	15.13±1.66a	947.96±31.18a
	Female	9.70±0.20a	20.13±1.80a	17.93±2.67a	31.84±1.2a	10.32±1.89a	13.76±1.55a	879.08±59.39b

*Means with different alphabets within the same column are significantly different (p<0.05)

Table 6 Effect of sex on morphometric traits of cross bred rabbits

Week	Sex	Ear length (cm)	Breast girth (cm)	Tail length (cm)	Body length (cm)	Trotter length (cm)	Height at withers (cm)	Body weight (g)
3	Male	5.43±0.17a	18.19±0.53a	3.91±0.13a	16.23±0.79a	10.16±0.88a	5.82±0.17a	199.47±10.32d
	Female	5.48±.19a	14.64±0.30a	3.91±0.18a	16.41±0.69a	11.33±0.98a	6.17±0.25a	188.05±10.86d
6	Male	7.59±0.19a	19.48±0.32a	6.65±0.16a	24.27±0.49a	18.51±0.31a	7.48±0.20a	398.62±28.05b
	Female	7.37±0.23a	19.13±0.35a	6.490±0.21a	24.40±0.70a	18.62±0.44a	7.66±0.26a	313.55±31.18c
9	Male	9.00±0.12a	22.18±0.28a	7.90±0.13a	28.11±0.42a	21.45±0.25a	9.03±0.17a	697.40±25.62a
	Female	8.95±0.11a	21.79±0.26a	8.56±0.81a	28.37±0.48a	21.45±0.28a	9.03±0.23a	608.42±23.32b
12	Male	10.22±0.11a	25.12±0.32a	9.52±0.16a	33.57±0.47a	23.42±0.46a	10.48±0.1a	822.59±29.74a
	Female	9.90±0.16a	25.12±0.36a	8.97±0.18a	32.78±0.44a	23.73±0.25a	10.87±0.4a	677.95±28.31b

*Means with different alphabets within the same column are significantly different (p<0.05)

Table 7: Estimation of correlation between morphometric traits of pure bred rabbit at week 3

Traits	Body weight	Ear length	Breast girth	Tail length	Body length	Trotter length	Height at withers
Body weight	1						
Ear length	-0.12	1					
Breast girth	0.14	-0.11	1				
Tail length	-0.12	0.35**	-0.74**	1			
Body length	0.16	0.41*	0.52**	-0.38**	1		
Trotter length	0.26*	-0.04	0.75**	-0.89**	-0.65**	1	
Height at withers	-0.24*	0.40*	-0.71**	0.93**	-0.42*	-0.84**	1

* Significant correlation (p<0.05); **Highly significant correlation (p<0.01)

Table 8: Estimation of correlation between morphometric traits of cross bred rabbit at week 3

Traits	Body weight	Ear length	Breast girth	Tail length	Body length	Trotter length	Height at withers
Body weight	1						
Ear length	-0.17	1					
Breast girth	-0.21*	0.16	1				
Tail length	0.16	0.39**	0.21*	1			
Body length	-0.10	0.19	0.12	0.66**	1		
Trotter length	-0.34**	0.15	0.14	0.36**	0.43**	1	
Height at withers	-0.58*	0.36**	-0.24*	0.32*	-0.49**	0.46**	1

*Significant Correlation (p<0.05); **Highly Significant Correlation (p<0.01)

At week 6, correlation estimation studies between morphometric traits of pure bred rabbit established a positively high (p<0.01) correlation between body weight and body length (r = 0.42). At week 6, a significant (p<0.05) correlation was recorded between ear length and tail length (r = 0.32), also a highly significantly (P<0.01) correlation existed between ear length and height at withers (r = 0.40). Breast girth established an evidently high (p<0.01) relationship with body length (r = 0.81) and trotter length (0.97). A highly significant (p<0.01) relationship was recorded between tail length and body length (r = 0.68) whereas trotter length recorded a highly correlated association with body length (r = 0.86) as shown in Table 9. Also at week 6, correlation estimation studies between morphometric traits of cross bred rabbit showed that ear length established a positively high (p<0.01) relationship with breast girth (r = 0.58), tail length (r = 0.63), body length (r = 0.43), trotter length (r = 0.77) and height at withers (r = 0.67). In similar trend, breast girth recorded a highly positive (p<0.01) association

with tail length (r = 0.47), body length (r = 0.58), trotter length (r = 0.75) and height at withers (r = 0.59). Also, tail length recorded a highly positive (p<0.01) relationship with body length (r = 0.68), trotter length (r = 0.56) and height at withers (r = 0.39). Body length showed a highly significant (p<0.01) association with trotter length (r = 0.50) and height at withers (r = 0.42) while trotter length established an evidently (p<0.01) correlated relationship with height withers as shown in Table 10.

Table 9: Estimation of correlation between morphometric traits of pure bred rabbit at week 6

Traits	Body weight	Ear length	Breast girth	Tail length	Body length	Trotter length	Height at withers
Body weight	1						
Ear length	0.23*	1					
Breast girth	0.15	-0.17	1				
Tail length	0.02	0.32*	-0.92**	1			
Body length	0.42**	0.15	0.81**	0.68**	1		
Trotter length	0.21*	-0.07	0.97**	-0.90**	0.86**	1	
Height at withers	-0.55*	0.40**	0.96**	-0.70**	-0.70**	-0.90**	1

* Significant correlation (p<0.05); ** Highly significant correlation (p<0.01)

Table 10: Estimation of correlation between morphometric traits of cross bred rabbit at week 6

Traits	Body weight	Ear length	Breast girth	Tail length	Body length	Trotter length	Height at withers
Body weight	1	-					
Ear length	0.13	1					
Breast girth	-0.28*	0.58**	1				
Tail length	-0.57**	0.63**	0.47**	1			
Body length	-0.54**	0.43**	0.58**	0.68**	1		
Trotter length	-0.30**	0.77**	0.75**	0.56**	0.50**	1	
Height at withers	-0.22*	0.67**	0.59**	0.39**	0.42**	0.76**	1

* Significant correlation (p<0.05); ** Highly significant correlation (p<0.01)

At week 9, correlation estimation studies between morphometric traits of pure bred rabbit showed that body weight established a positively high (p<0.01) relationship with ear length (r = 0.47), breast girth (r = 0.0.33), body length (r = 0.43) and significant relationship (p<0.05) with trotter length (r = 0.32). Body girth established a highly evident (p<0.01) association with (r = 0.83), trotter length (r = 0.83) and a significant (p<0.05) relationship with body length (r = 0.84). In the same pattern, tail length recorded a highly evident (p<0.01) correlation with body length (r = 0.80) and height at withers (r = 0.94) as shown in Table 11. At week 9, correlation estimation studies between morphometric traits of cross bred rabbit showed that body weight established a positively evident (p<0.01) relationship between ear length (r = 0.61), body length (r = 0.29), trotter length (r = 0.46) and a positive significant (p<0.05) correlation with breast girth (r = 0.291). Ear length recorded highly significant (p<0.01) association with breast girth (r = 0.39), body length (r = 0.59) and trotter length (r = 0.49). In addition, breast girth established a significant (p<0.05) relationship with body length (r = 0.33), height at withers (r = 0.310) and highly positive (p<0.01) relationship with trotter length (r = 0.48) while body length showed a highly significant (p<0.01) correlation with trotter length (r = 0.52) as shown in Table 12.

Table 11: Estimation of correlation between morphometric traits of pure bred rabbit at week 9

Traits	Body weight (g)	Ear length	Breast girth	Tail length	Body length	Trotter length	Height at withers
Body weight	1						
Ear length	0.46**	1					
Breast girth (cm)	0.33**	0.03	1				
Tail length	-0.09	0.14	0.83**	1			
Body length	0.43**	0.10	0.87*	0.80**	1		
Trotter length	0.32*	0.11	0.83*	-0.93**	0.82**	1	
Height at withers	0.00	0.23*	-0.84**	0.94**	-0.80**	-0.81*	1

* Significant Correlation (p<0.05); ** Highly Significant Correlation (p<0.01)

Table 12: Estimation of correlation between morphometric traits of cross bred rabbit at week 9

Traits	Body weight	Ear length	Breast girth	Tail length	Body length	Trotter length	Height at withers
Body weight	1						
Ear length	0.61**	1					
Breast girth	0.29*	0.39**	1				
Tail length	-0.35**	0.14	0.07	1			
Body length	0.64**	0.58**	0.33*	0.12	1		
Trotter length	0.46**	0.49**	0.48**	0.19	0.52**	1	
Height at withers	0.12	0.22*	0.31*	0.08	0.12	0.11	1

* Significant Correlation (p<0.05); ** Highly Significant Correlation (p<0.01)

At week 12, correlation estimation studies between morphometric traits of pure bred rabbit showed that body weight established a high positive (p<0.01) relationship with breast girth (r = 0.41), tail length (r = 0.40) and body length (r =0.48), ear length showed a highly correlated (p<0.01) association with breast girth (r = 0.70) and tail length (r = 0.48) and positive association (p<0.05) with trotter length (r = 0.35). Breast girth established a positively correlated (p<0.01) relationship with tail length (r = 0.45) and body length (r = 0.41). Similarly, tail length established a positively high relationship with body length (r = 0.51) as shown in Table 13. At week 12, correlation estimation studies between morphometric traits of cross bred rabbit showed that body weight established a positive (p<0.05) relationship with tail length (r = 0.38) and height at withers (r = 0.39), breast girth established a significantly (p<0.01) evident relationship with body length (r = 0.90) and trotter length (r = 0.95). Similarly, tail length showed a highly (p<0.01) evident relationship with (r = 0.99), body length equally established a highly positive (p<0.01) relationship trotter length (r = 0.93) while trotter length established a positively correlated relationship with height at withers (r = 0.95) as shown in Table 14.

Table 13: Estimation of correlation between morphometric traits of pure bred rabbit at week 12

Traits	Body weight	Ear length	Breast girth	Tail length	Body length	Trotter length	Height at withers
Body weight	1						
Ear length	0.30*	1					
Breast girth	0.41**	0.70**	1				
Tail length	0.40**	0.48**	0.45**	1			
Body length	0.48**	0.22*	0.41**	0.51**	1		
Trotter length	0.04	0.35*	0.07	0.19	0.22*	1	
Height at withers	-0.06	-0.31*	-0.42**	-0.40**	-0.28*	-0.24*	1

NS: Non-significant; * Significant Correlation (P<0.05); ** Highly significant correlation (P<0.01)

Table 14 Estimation of correlation between morphometric traits of pure bred rabbit at week 13

Traits	Body weight	Ear length	Breast girth	Tail length	Body length	Trotter length	Height at withers
Body weight	1						
Ear length	0.22*	1					
Breast girth	-0.25*	0.10	1				
Tail length	0.38*	0.19	-0.87**	1			
Body length	-0.20*	0.14	0.90**	-0.88**	1		
Trotter length	-0.20*	0.03	0.95**	-0.96**	0.93**	1	
Height at wither	0.39*	0.20*	-0.83**	0.994**	-0.80**	0.95**	1

* Significant Correlation (p<0.05); ** Highly Significant Correlation (p<0.01)

DISCUSSION

At week 12, genotype of rabbit exerted an evident influence on body weight and other morphometric traits examined with cross bred NZR x CH genotype showing a superior performance in terms of ear length, breast girth, and body length with pure bred NZR x NZR genotype showing supremacy in body weight and trotter length. The bigger and heavier size advantage of pure bred NZR x NZR genotype over its cross bred contemporaries suggests that genetic difference promotes high growth rate which also increase body weight (Jeffrey and Berg, 1972). It was observed that body weight proportionately increases with increase in age. This is expected, because as the animal grows, body size and shape are also expected to increase simultaneously with age (Hamayun*et al.*, 2006; Fajemilehin and Salako, 2008). Sexual dimorphism is an excellent source of variation for live body weight. Across genotypes, sexual dimorphism evidently influenced body weight with bucks showing supremacy in body weight indicating that bucks were bigger and heavier than the does (Hamayun *et al.*, 2006 and

Akpa *et al.,* 1998). Sexual dimorphism-related differences might be partly a function of the between-sex differential hormonal effects on growth (Jimmy *et al.*, 2010). Sexual differences did not influence other morphometric traits examined. This confirms earlier reports of Olutogun *et al.* (2003) that sex confers a non-significant influence on some morphometric traits

At weeks 3, 6, 9 and 12 a positively evident correlation co-efficient was established between body weight and other morphometric traits considered in both pure and cross bred genotype. This interrelationship reveals that a unit increase in body weight exaggerates equivalent unit increase in body length, breast girth, height at withers, tail length and trotter length (Ngere *et al*., 1979; Mukherjee *et al*., 1981; Moruppa *et al.,* 1986; Osinowo *et al*., 1989 and Adewumi *et al*., 2006). This corroborates earlier findings of Adewumi *et al.* (2006) that established relationship between body weight and some morphometric traits indicates that these correlated traits could jointly be selected, such that an improvement in one morphometric trait proportionately leads to simultaneous improvement in the other (Raymond *et al.*, 1987; Buvanendran *et al.,* 1980; Olutogun *et al.,* 2003). The high and significant correlation co-efficient between body weight and body length, body weight and height girth and, height girth and height at withers, body weight and tail length, breast girth and body length, body length and ear length, and relationship between other correlated morphometric trait also suggests that morphometric measurements could be an excellent traits for predicting live body weights of animals without taking them to weigh bridge or weighing scale (Hassan and Adamu, 1997).

CONCLUSION

It can be concluded that genetic differences due to genotype is critical to weight gain and size of rabbits where crossbred genotype is longer than the pure bred genotype while pure bred genotype is heavier than the crossbred genotype. Therefore, pure and crossbred exotic rabbits are genetically beneficial with bucks showing bigger size advantage relative to does for increased meat yield and positively significant correlation between body weight and some selected morphometric traits e.g. body length, trotter length, ear length, breast girth, height at withers inform that they could be used in breed selection, improvement and morphometric traits prediction programs.

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