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The Performance of Mongrel Rabbits in a Tropical Environment

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ABSTRACT

A total of sixty progenies were used to evaluate growth traits comprising of body weight and linear body parameters in mongrel rabbits, estimate phenotypic correlations among growth traits and develop regression models to predict body weight using linear body measurements. Body weight and linear body measurements comprising; Ear length, Heart girth, Body length, Fore-limb, Hind limb and Tail length were taken from 8 weeks to 16 weeks of age. Results showed that age exerted ($P < 0.05$) significant influence on all growth traits. Positive and strong association was observed between body weight and all linear body parameters throughout the period of the study. This implies that, an improvement in any of linear parameters will bring about an improvement in body weight vice versa. Body weight was significantly predicted using linear body measurements with high to medium degree of validity. Higher validity was observed in the multiple model when more traits were fitted into the prediction equation.

INTRODUCTION

Livestock farming provides a means of improving food insecurity and insufficient animal protein in Nigeria^[1]. Protein from livestock which are not readily considered in animal husbandry are being explored^[2]. Domestic rabbits falls in this category, and is of advantage due to its; fast growth rate, ability to convert 20% forage to meat, short gestation period, high prolificacy, high protein level (20.8-21.3%), rich in vitamins and minerals, low in sodium, fat, and cholesterol, making it of high nutritive value^[3-5]. Growth in all animals is a complex process controlled by both genetic and non-genetic factors. Although the growth performance of an animal is a phenotypic attribute influenced by the environment, to a large extent however, it is a manifestation of the genetic constitution of the animal^[6].

Growth performance and body conformation traits are important parameters in assessing the potential of mongrel rabbits to enhance their contribution to the much-needed animal protein in Nigeria. Morphological variation within species is of great biological interest both as descriptive and analytical tool. Sexual dimorphism on morphological traits is important in descriptive studies to characterise population composition and evaluate the genetic variation within and between populations of rabbits. Thus, the knowledge obtained will be essential in planning breeding programmes and in adopting breeding strategies. It will also be essential in assessing growth rate of mongrel rabbits.

Correlations expresses the relationships between phenotypic values of the animals, which could be seen on the performance of the animals. The knowledge of the relationships between body weight and growth traits (correlation) are useful tools for breeders in selecting animals as breeding stock and for predicting body weight^[7]. Obasi *et al.* reported positive and significant phenotypic correlations between linear body measurements and bodyweight indicating that an improvement in one trait would lead to a corresponding improvement in the other provided environmental influence is excluded.

MATERIALS AND METHODS

A total of 60 weaner mongrel rabbits comprising of 30 males and 30 females were used for the study. They were housed individually in three tier wooden hutches of 60 cm x 60 cm and 60 cm from the ground. The hutches were thoroughly washed with detergent and disinfected a week to the arrival of the rabbits. Rabbits were flushed qualitatively a week to mating and then mated at the ratio of 3:1 female to male. Tag numbers were assigned to each hutch and each rabbit was systematically ear numbered

with permanent marker for easy identification. Concrete drinkers and feeders were provided. Rabbits were fed ad libitum with grower's mash (top feed) and supplemented with forages such as *Centrosema pubescens*, *Panicum maximum* as suggested by Obasi *et al.*,^[2]. Clean water was provided daily. Matured rabbits and rabbits at weaning were given Ivomec injections against endo-parasites and ecto-parasites. Kitten were sexed and weaned at the 8th week. Prophylactic medications were administered to weaning rabbits against prevalent rabbit infections such as, coccidiosis, mucoid enteritis, pasteurellosis, etc. Multivitamins were administered in drinking water to boost appetite.

Data Collection: The following data were collected: Body weight(g) of the kittens, measured using sensitive scale weighing balance (top loading pan scale of 20 kg capacity with 0.01 kg accuracy) and Linear body measurements (LBM cm) comprising of: Body length (BL): length between the neck region to the base of the tail, Heart girth (HG): body circumference of chest region, Length of forelimb (LFL): length from the base of ulna bone to the tip of the feet, Length of hind limb (LHL): length from the base of the pelvic bone to the tip of the feet, Tail length (TL): length from the base to the tip of tail and Ear length (EL): length from the base to the tip of ear (cm) all measured weekly from 8 weeks to 16 weeks using tailor's tape.

Experimental Design: Data collected were subjected to analysis of variance in completely randomized design (CRD) using SPSS, significant means were separated by Duncan multiple range test (DMRT).

RESULTS AND DISCUSSIONS

Growth pattern of Mongrel rabbits from week 8 to 16: Mongrel rabbit according to the result obtained in this study (table 1) had progressive increase in body weight from week 8 to week 16, this conforms to the report of Onasanya *et al.*,^[8] who observed that body weight proportionately increases with increase in age. Lamptey *et al.*,^[9] also noted that rabbits have progressive growth which is more rapid at the early stage of growth. Linear body parameters also had corresponding increase as body weight was increasing. This agrees with the findings of Sam *et al.*,^[10] who observed that linear body measurements increased as bodyweight increased. The result implies that growth is influenced by age.

The body weight of mongrel rabbits recorded in this study at week 8 agrees with Sam *et al.*,^[10] in Chinchilla × New Zealand white but disagreed with Lamptey *et al.*,^[9] in domestic rabbits. The slight difference could be due to breed differences. Body weight of mongrel rabbits at week 12 is in line with

Table 1: Body weight and linear body measurements for week 8, 10, 12, 14 and 16

	Mean ± SEM				
	Week 8	Week 10	Week 12	Week 14	Week 16
Body Weight	501.83±9.67 ^e	684.67±10.95 ^d	896.92±13.05 ^c	1088.67±15.32 ^b	1300±16.35 ^a
Ear Length	8.36±0.06 ^e	8.85±0.58 ^d	9.63±0.06 ^c	10.13±0.05 ^b	10.62±0.05 ^a
Heart Girth	16.76±0.13 ^e	18.41±0.13 ^d	21.10±0.14 ^c	22.88±0.16 ^b	24.88±0.20 ^a
Body Length	30.60±0.18 ^e	32.88±0.17 ^d	35.38±0.18 ^c	37.36±0.18 ^b	39.89±0.24 ^a
Fore limb	10.88±0.06 ^e	11.66±0.07 ^d	12.74±0.89 ^c	13.69±0.08 ^b	14.74±0.10 ^a
Hind Limb	15.47±0.10 ^e	16.70±0.10 ^d	18.36±0.10 ^c	19.89±0.13 ^b	21.42±0.14 ^a
Tail length	6.66±0.06 ^e	7.33±0.52 ^d	7.98±0.57 ^c	8.49±0.06 ^b	8.98±0.06 ^a

a,b,c = means in a row within a parameter with different superscripts are significantly (p<0.05) different from each other

Table 2: Average Daily Gain of Mongrel Rabbit

Parameters	Mean ± SEM			
	Week 8-10	Week 10-12	Week 12-14	Week 14-16
Body Weight	13.06±0.39 ^b	15.16±0.48 ^a	13.83±0.54 ^{ab}	15.10±0.62 ^a
Ear Length	0.04±0 ^b	0.06±0 ^a	0.04±0.01 ^b	0.04±0 ^b
Heart Girth	0.12±0.01 ^c	0.19±0.01 ^a	0.13±0.03 ^{ab}	0.14±0.16 ^b
Body Length	0.16±0.01 ^{ab}	0.18±0.01 ^a	0.14±0.04 ^b	0.18±0.01 ^a
Fore limb	0.06±0 ^b	0.08±0 ^a	0.07±0.02 ^{ab}	0.08±0.01 ^a
Hind limb	0.09±0 ^b	0.12±0 ^a	0.11±0.02 ^a	0.11±0.01 ^a
Tail length	0.05±0 ^a	0.05±0 ^a	0.04±0.01 ^b	0.04±0 ^b

a b c = means in a row within a parameter with different superscripts are significantly different

Table 3: Phenotypic correlation of body weight and linear body measurement at week 8 (above diagonal) and week 10 (below diagonal)

	BW	EL	HG	BL	FL	HL	TL
BW		0.637**	0.752**	0.664**	0.577**	0.542**	0.554**
EL			0.444**	0.607**	0.457**	0.254	0.266*
HG	0.602**		0.443**	0.573**	0.489**	0.393**	
BL	0.642**	0.500**		0.520**	0.520**	0.501**	0.404**
FL	0.513**	0.514**	0.513**		0.544**	0.377**	0.270*
HL	0.672**	0.374**	0.477**	0.582**		0.458**	0.459**
TL	0.587**	0.260*	0.356**	0.432**	0.416**	0.516**	

BW = body weight, EL = ear length, HG = hearth girth, BL = body length, FL = fore limb, HL = hind limb, TL = tail length ** = highly significant P < 0.01 * = significant P < 0.05

Onasanya *et al.*,^[8] in California white x New Zealand white cross bred rabbits, Sam *et al.*,^[10] and Rotimi^[11] in New Zealand white x Chinchilla cross bred rabbits.

Body length at week 8 is lower than that obtained by Ologbose *et al.*,^[12] but higher than that of Sam *et al.*,^[10]. Similarly, body length at week 12 is lower than that reported by Ologbose *et al.*,^[12]. However, body length in the other weeks (14-16) is likewise, higher than those obtained by other authors, apparently due to the differences in breeds used and the environment. According to Sam *et al.*,^[10] and Adamu *et al.*,^[13], variation of some morphometric traits among different genotypic groups could be attributed to the influence of genetic makeup on growth rate and body weight.

Ear length is in line with the values obtained by Onasanya *et al.*,^[8], Anya *et al.*,^[14], Rotimi^[11] and Sam *et al.*,^[10]. All working with different breeds rabbits, this might imply that ear length of rabbits has same pattern of growth across the breeds.

Hearth girth of mongrel rabbits at week 8 is lower than that obtained by Ologbose *et al.*,^[12] and Sam *et al.*,^[10]. The difference could be ascribed to the difference in breeds and the environment. Heart girth at week 12 is in line with Ologbose *et al.*,^[12], slightly higher than that of Rotimi^[11] but aligns with Anya *et al.*,^[14] in matured rabbits.

Fore limb value was lower than that of Ologbose *et al.*,^[12] but in line with Anya *et al.*,^[14] in matured rabbits.

Hind limb value reported in this study was slightly lower than that of Ologbose *et al.*,^[12] but in line with Anya *et al.*,^[14]. Tail length obtained was lower than that of Onasanya *et al.*,^[12] but in line with Anya *et al.*,^[14].

These variations point to the fact that genetic differences and the environment in which animals are maintained impacts on their performances.

Average Daily Gains in Body weight and linear body measurements of Mongrel Rabbits:

The average daily gains of mongrel rabbit are presented in table 2. There were gains in body weight and linear body measurements from week 8 to week 16. The average daily body weight gain obtained in this study is lower than the values obtained by El Sawy *et al.*,^[15] in New Zealand rabbits. This could be attributed to the difference in breeds and age of rabbits used in this study. However, the range of values agrees with Idowu *et al.*,^[16] in mixed breed of rabbits at week 7 to week 10 and Al-Amin *et al.*,^[17]. Age had significant (p<0.05) effect on the body weight gains and gains in linear body measurements obtained in this study. This implies that the animals gained weight with age.

Phenotypic Correlations between Body Weight and Linear Body Measurements of Mongrel Rabbit:

Mongrel rabbits recoded positive and strong association between body weight and linear body measurements all through the period of this study as presented in table 3. This is in line with the works of

Table 4: Phenotypic correlation of body weight and linear body measurement at week 12 (above diagonal) and week 14 (below diagonal)

	BW	EL	HG	BL	FL	HL	TL
BW							
EL	0.500**						
HG	0.353**	0.318*					
BL	0.667**	0.608**	0.587**				
FL	0.499**	0.223	0.364**	0.519**			
HL	0.556**	0.438**	0.313*	0.544**	0.536**		
TL	0.529**	0.540**	0.169	0.536**	0.341**	0.532**	

BW = body weight, EL = ear length, HG = hearth girth, BL = body length, FL = fore limb, HL = hind limb, TL = tail length ** = highly significant P < 0.01 * = significant P < 0.05

Table 5: Phenotypic correlation of body weight and linear body measurement at week 16

	BW	EL	HG	BL	FL	HL	TL
BW		0.496**	0.236	0.681**	0.679**	0.618**	0.398**
EL			0.182	0.622**	0.418**	0.580**	0.454**
HG				0.459**	0.257*	0.184	-0.005
BL					0.709**	0.717**	0.422**
FL						0.648**	0.463**
HL							0.387**
TL							

BW = body weight, EL = ear length, HG = hearth girth, BL = body length, FL = fore limb, HL = hind limb, TL = tail length ** = highly significant P < 0.01 * = significant P < 0.05

Table 6: Simple and Multiple Regression models for predicting Body Weight of Mongrels Rabbits for week 8, 10, 12, 14 and 16

Simple Prediction Equation	R ² (%)	S.E	Sig	Multiple prediction Equation	R ² (%)	S.E	Sig
BW = -469.65 + 57.97 HG	57	49.75	**	BW = -953.22 + 30.18 HG + 12.09 BL + 42.01 TL + 35.84 EL	72	40.80	**
BW = -595.50 + 76.66 HL	45	63.41	**	BW = -967.23 + 42.54 HL + 27.59 HG + 59.21 TL	61	54.41	**
BW = -777.40 + 46.71 BL	42	77.43	**	BW = -1168.76 + 17.43 BL + 46.57 FL + 51.83 TL + 20.97 HG	60	65.97	**
BW = -1026.54 + 56.62 BL	45	89.13	**	BW = -1180.62 + 43.94 BL + 31.56 HL	50	85.50	**
BW = - 579.67 + 47.13 BL	46	93.58	**	BW = - 800.63 + 27.77 BL + 67.39 FL	54	87.35	**

BW = body weight, EL = ear length, HG = hearth girth, BL = body length, FL = fore limb, HL = hind limb, TL = tail length, ** = highly significant P < 0.01 * = significant P < 0.05

Ologose *et al.*^[12], Obasi *et al.*^[2] and Sam *et al.*^[10] who reported positive association between body weight (BW) and linear body measurement (LBM). Body weight and hearth girth (HG) showed the highest phenotypic correlation between body weight and linear body measurements at week 8 followed by body weight and body length (BL). Ologose *et al.*^[12] and Sam *et al.*^[10] observed that HG and BL had the highest association with BW at week 8. The strong association recorded between BW and (HG and BL) is an indication that HG and BL can be used to predict BW at 8 weeks of age as well as in selection for improvement of growth traits.

LBM showed positive phenotypic correlation at week 8 ranging from very high to low which implies that all the linear parameters had the same direction of growth though at different rate. The strongest correlation amongst LBM was obtained between heart girth and ear length (EL) which implies that the selection of one would result in great benefit to the other. Ear length and hind limb (HL) had the least correlation, which implies that selection for one would have the least benefit on the other. A high correlation between one trait and others result in an improvement on such a trait as well as result in a corresponding improvement in such other traits^[12,10].

Phenotypic correlation between body weight and linear body measurement observed at week 10, were all positive and highly significant (p<0.01). The highest correlation in this study was obtained between BW and HL followed by BW and BL, while the least correlation was with el. LBM all expressed positive correlations, the strongest association was between BL and HG while the least was between EL and TL. Sam *et al.*^[10] who recorded positive correlation between BW and LBM at week 10, while Ayo-Ajasa *et al.*^[18] reported BL and HG to have high correlation between each other and can be selected for improvement.

BW had positive and significant correlation (p<0.01) with all LBM studied at week 12 which is presented in table 4. The highest correlation was with BL, while the least was EL This implies that BL is the most suitable for selection at week 12. LBM all had positive correlation with each other, the strongest was between BL and EL while the weakest was between EL and TL. This in line with Obasi *et al.*^[2], who equally obtained positive correlation at week 12 in their study.

Phenotypic correlation between BW and LBM at week 14 was positive and highly significant (p<0.01). BL had the strongest association while HG had the weakest. Correlation on LBMs were all

positive. BL and EL had the strongest association as such selection for BL will result in an improvement in EL, while HG and TL had the weakest correlation which will result in a reduction in TL if HG is selected for improvement.

There was positive correlation between BW and other LBM at week 16 expect for hearth girth and tail length which was negative (Table 5). This is in line with Obasi *et al.*,^[2] Sam *et al.*,^[10] and it signifies that the selection of one for improvement would result in a reduction in the other. The best correlation between BW and LBM was BL while amongst LBM was between BL and HL, implying that body length (BL) if selected for improvement at week 16, will positively affect all growth traits.

It is observed that correlation coefficient in all ages between BW and LBMs were positive, this means that as the LBMs or BW is increasing, a corresponding increase is expressed in the other. This mean that as any one linear body measurement or body weight is increasing, a corresponding increase is expressed in the other. The result Implies that, the improvement of body weight would result in a corresponding improvement of all the linear body measurements. The high and positive phenotypic correlations observed among the linear body measurements indicate high genetic variation, which supports high selection response. Implying that, any of the linear body parameters can be selected for improvement of body weight and that these correlated traits could jointly be selected, such that an improvement in one linear body measurement proportionately leads to simultaneous improvement in the other. This shows that growth in mongrel rabbit is asymmetrical with other parts indicating that as the rabbit grows, all the other parts are growing concurrently.

Prediction of Growth Traits of Mongrel Rabbits: BW was significantly ($P < 0.05$) predictable from LBMs obtained in this study for mongrel rabbits using both simple and multiple regression models (table 6). Prediction was possible since there were high and positive correlations between BW and LBMs. This agrees with Sam *et al.*^[10] who reported that linear body measurements with high and positive correlation with body weight of rabbits can be used in body weight prediction which is essential in animal improvement. At week 8, heart girth (HG) was the best linear parameter used for prediction, it had the highest correlation with body weight and can therefore be selected for genetic improvement. Ologose *et al.*^[12] also observed (HG) to be the most preferred single predictor at week 8. The highest Coefficient of determination (R^2) in the simple and

multiple regression models respectively, were obtained at week 8 of this study. This implies that prediction was most reliable at this week. At week 10, HL was the best linear parameter for BW prediction while BL was the best linear parameter for prediction in weeks 12-16. This implies that BL should be used for weight prediction in older mongrel rabbits. Higher R^2 values were obtained in the multiple regression equations where more linear parameters were used, indicating that multiple regression model would be more reliable which agrees with Udoh and Udofot^[7] who reported increased reliability of prediction model when more linear parameters are used for predictions.

CONCLUSION

Body weight of Mongrel rabbits increased gradually from week 8 to 16 indicating that age exert influence on the growth of animals. Linear body parameters had corresponding increase with body weight. Significant interactions were observed in some linear body parameters and also in daily gains of linear body parameters. Body weight had positive and strong association with linear body measurements in all ages of this study. Heart girth (HG) had very high association with body weight at week 8 to 10 while, body length (BL) recorded very high association from weeks 8 to 16 making them good traits for selection in the improvement of mongrel rabbits. Positive regression coefficients were obtained from linear body parameters in body weight prediction implying that linear parameters can be used in body weight prediction of mongrel rabbits.

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