

Predication of body weight of the domestic rabbit at different stages of growth using linear body measurements

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Abstract

Data on body weight and linear body measurements (LBMs) namely ear length (EL), body width (BW), body length (BL), Head to shoulder (HS), Shoulder to tail (ST) and length of leg (LL) of 363 progeny of locally adapted Dutch, New Zealand White and crossbred rabbits at 3, 6, 9 and 12 weeks of age were analyzed to obtain phenotypic correlations between the various traits and prediction equations for body weight, using different linear body measurements. There were high and positive correlations between each of the linear body measurements and body weight and between the LBM themselves. The values ranged between 0.51 and 0.85, 0.34 and 0.89, 0.27 and 0.83 and 0.41 and 0.75 in weeks 3, 6, 9 and 12, respectively. Hence, it was possible to predict body weight of live rabbits from their linear body measurements, as an aid to farmers in areas where sensitive scales are not available. Except in purebred New Zealand White NZWxNZW, body length (BL) was a good predictor of 3-week body weight (IBW) in all breed groups. Body width (BW) and BL only were good predictors of 6-week body weight in all breed groups. For predicting 9-week body weight, shoulder to tail drop (ST) was important in all breed groups in addition to either BW, ear length (EL) or body length (BL). ST and BW were important predictors of 12-week body weight generally in all breed groups.

Keywords: Domestic rabbit, linear body measurements, body weight, prediction model.

Introduction

In recent times, rabbit keeping has gained ground among Nigerian households and researchers as an alternative source of animal protein and experimental material. Its potential in cushioning the effect of World Food Shortage has been stressed (Chen *et al.*, 1978).

The growth rate of rabbit is comparable to that of broiler chicken (Rao *et al.*, 1977). The live weight of any animal is an important variable that determines the market value of the animal.

Also the exact time at which an animal is ready for slaughter can be assessed on the basis of its body weight and general development.

However, where scales are not readily available, as is the case in most rural African farming communities and meat markets (Mani *et al.*, 1991; Nesamvuni *et al.*, 2000), linear body measurements have been used to predict live weights in poultry (Monsi, 1992; Okon *et al.*, 1997; Gueye *et al.*, 1998), goats (Hassan and Ciroma, 1992; Ozoje and Herbert, 1997), sheep

(Kandasamy and Gupta, 1983) and cattle (Orheruata and Olutogun, 1994).

The relationships existing among linear body measurements traits provide useful information on performance, productivity and carcass characteristics of animals. These traits are less subjected to short term changes as is body weight and allow comparisons of growth in different part of the body (Russell, 1975). Besides, body weight and linear body measurements of meat animals have been found useful in quantifying body size and shape (Ibe, 1989; Ibe and Ezekwe, 1994). Information on the interrelationships among linear body measurements of rabbits in the humid tropics is scanty in available literature. Abudullah *et al.* (2003) reported that shoulder to tail length is the best predictor of body weight in rabbit, followed by body length and heart girth. The objectives of this study were to estimate phenotypic correlations between body weight and various linear body measurements and between the linear body measurements themselves and to establish models for predicting body weight of domestic rabbits at various ages of growth using linear body measurements.

Materials and methods

Body weight and linear body measurements of 363 progeny resulting from the matings of locally adapted Dutch (DTH), New Zealand White (NZW) and their crossbreds at 3, 6, 9 and 12 weeks of age were analyzed. Forty (40), Ten (10), Thirty (30), and Twenty Three (23) progeny occurred for NZWxNZW, NZWxDTH, DTHxDTH and DTHxNZW, respectively. The experimental rabbits were reared in cages at the Rabbit Unit of the Teaching and Research Farms, Michael Okpara University of Agriculture, Umudike, Nigeria.

The animals were fed pelleted ration containing 16.5% crude protein and 2.8 kcal/kg gross energy *ad-libitum* along with greens (*Panicum maximum*, grass and *Centrosema pubescens*, Legume). Fresh clean water was supplied regularly. The body weight (IBW) in grams of each animal was recorded on weekly basis before feeding by using a 20 kg weighing scale, while the following linear body measurements, namely ear length (EL), body width (BW), body length (BL), head-to-shoulder (HS), shoulder-to-tail (ST) and length of leg (LL) were taken on each animal using a tailor's tape. All linear measurements were in centimeter. The data collected were analyzed to estimate the phenotypic correlations between pairs of these traits using Harvey's (1990) Least Squares and Mixed Model computer programme.

The stepwise variable selection procedure of SPSS statistical programme (1987) was used to determine the most appropriate model for predicting body weight, using linear body measurements. The generalized prediction model is as follows:

$$Y_i = a + \sum_{i=k}^K b_i X_i + e_i$$

Where;

- Y_i = Dependent variable (body weight)
- a = Intercept on the Y – axis.
- b_i = Partial regression coefficients
- X_i = Independent variables (i.e the linear body measurements)
- e_i = Random error, identically and independently normally distributed, with zero mean and constant variance [i ind $(0, \sigma^2)$]

Results and discussion

Phenotypic correlations between body weight and linear body measurements (LBM) and between the LBM themselves at 3, 6, 9 and 12

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weeks of age are presented in Tables 1, 2, 3 and 4, respectively. At the four stages of growth, all the linear body measurements, except HS at 9 weeks ($r_p = 0.27$), were strongly and positively

correlated with body weight. The values ranged between 0.51 and 0.85, 0.34 and 0.89, 0.27 and 0.83 and 0.41 and 0.75 in weeks 3, 6, 9 and 12, respectively.

Table 1: Coefficients of phenotypic correlation (r_p) among growth traits of rabbit at 3 weeks of age

Traits*	EL	BW	BL	HS	ST	LL
IBW	0.73	0.62	0.75	0.51	0.72	0.71
EL		0.66	0.83	0.59	0.84	0.82
BW			0.70	0.51	0.74	0.69
BL				0.59	0.85	0.79
HS					0.56	0.54
ST						0.83

*IBW = Individual body weight; EL = Ear Length
 BW = Body width; BL = Body Length;
 HS = Head to Shoulder; ST = Shoulder to Tail.
 LL = Length of Leg

Table 2: Coefficients of phenotypic correlation (r_p) among growth traits of rabbit at 6 weeks of age

Trait*	IBW	EL	BW	BL	HS	LL
IBW		0.71	0.81	0.89	0.64	0.50
EL			0.65	0.68	0.66	0.61
BW				0.69	0.51	0.53
BL					0.61	0.54
HS						0.34

*See Table 1 for explanation.

This observation is in consonance with the findings of Chineke (2000), Tiamiyu *et al.* (2000) and Abdullah *et al.* (2003), who, at various times, observed strong and positive correlation coefficient between body weight and linear body measurement. The strong and positive phenotypic correlation indicate that linear body measurement could be used to predict body weight with reasonable accuracy.

Multiple regression models to predict body weight at different ages of growth using linear body measurements are presented in Table 5. In all cases, the prediction equations were significant and had large coefficients of multiple

determination (R^2), which ranged between 65.3 and 93.7%. These indicate that the prediction equations obtained in this study can be used to predict the body weight of live rabbits at 3, 6, 9 and 12 weeks.

Except in NZWxNZW, body length (BL) was a good predictor of 3-week body weight (IBW) in all breed groups. Body width (BW) and BL only were good predictors of 6-week body weight in all breed groups. For predicting 9-week body weight, shoulder-to-tail drop (ST) was important in all breed groups in addition to either BW, ear length (EL) or BL/ST and BW were important predictors of 12-week body weight generally in all breed groups.

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Table 5: Regression equations relating body weight to linear body measurements at 3, 6, 9 and 12 weeks of age in the domestic rabbit

Breed Group	Prediction Equation*	R ² (%)	S.E.	SIG
NZW x NZW	IBW ₃ = -28966.62 + 42.108 EL ₃ + 20.465 LL ₃	82.4	3365.90	***
	IBW ₆ = -69094.49 + 31.185BL ₆ + 29.210BW ₆	84.7	3466.88	***
	IBW ₉ = -86515.60 + 33.096ST ₉ + 309.625BW ₉	78.7	4795.09	***
	IBW ₁₂ = -98473 + 0.0370ST ₁₂ + 3.095BW ₁₂	65.3	7328	***
NZW x DTH	IBW ₃ = -46426.08 + 42.063BL ₃	93.7	2004.33	***
	IBW ₆ = -86921.73 + 38.421BL ₆ + 31.758BW ₆	88.2	4496.80	***
	IBW ₉ = -160205.70 + 35.727ST ₉ + 1347.45EL ₉	85.7	6278.80	***
	IBW ₁₂ = -1530469 + 1.511EL ₁₂ + 4.344BW ₁₂	84.8	5767	***
DTH x NZW	IBW ₃ = -19241.62 + 24.358BL ₃	77.5	1893.57	***
	IBW ₆ = -55045.98 + 31.507BL ₆ + 19.708BW ₆	80.7	3756.43	***
	IBW ₉ = -50536.08 + 25.665ST ₉ + 245.591BW ₉	72.2	6176.71	***
	IBW ₁₂ = -1225.29 + 0.291ST ₁₂ + 2.180BW ₁₂ + 0.721HS ₁₂	85.9	52.62	***
DTH x DTH	IBW ₃ = -29568.09 + 20.926BL ₃ + 26.478HS ₃	91.0	1504.17	***
	IBW ₆ = -70254.48 + 31.796 BL ₆ + 28.617BW ₆	85.4	3848.48	***
	IBW ₁₂ = -113674.40 + 45.120BL ₁₂ + 24.525ST ₁₂ + 0.666ST ₁₂	82.2	4476.12	***
	IBW ₁₂ = -1239.73 + 0.666ST ₁₂	65.6	7089	***

*IBW₃, IBW₆, IBW₉, and IBW₁₂ = Individual body weight at 3, 6, 9 and 12 weeks of age, respectively; EL = Ear length; BW = Body width; ST = Shoulder to Tail drop; BL = Body length; LL = Length of Leg; HS = Head to shoulder; NZW = New Zealand White; DTH = Dutch; R² = Coefficient of Multiple Determination; SE = Standard Error; *** P < 0.001

The predicted body weight of rabbits using the prediction equation ranges from 201.11g at 3 weeks of age to 1175.25g at 12 weeks of age for the different breed groups. Abdullah *et al.*

(2003) reported that ST appears to be the best single predictor of body weight in rabbits, followed by BL, and BW.

Table 3: Coefficients of phenotypic correlation (r_p) among growth traits of rabbits at 9 weeks of age

Trait*	IBW	EL	BW	BL	HS	ST	LL
IBW		0.53	0.59	0.56	0.27	0.71	0.59
EL			0.59	0.69	0.38	0.70	0.74
BW				0.68	0.37	0.74	0.71
BL					0.43	0.75	0.81
HS						0.47	0.41
ST							0.83

*See Table 1 for explanation.

Table 4: Coefficients of phenotypic correlation (r_p) among growth traits of rabbits at 12 weeks of age

Trait*	IBW	EL	BW	BL	HS	ST	LL
IBW		0.58	0.74	0.71	0.68	0.75	0.60
EL			0.48	0.60	0.41	0.49	0.50
BW				0.65	0.47	0.57	0.50
BL					0.53	0.63	0.63
HS						0.60	0.54
ST							0.51

*See Table 1 for explanation.

This tool can be relevant in some rural African farm communities where sensitive weighing scales are not readily available in the market (Mani *et al.*, 1991; Nesamvuni *et al.*, 2000). Also, the high cost of weighing balance and the attendant need for technical know-how in its usage may necessitate the use of tailor's tape that is cheap and readily available in obtaining predicted live weights from certain linear body measurements.

Furthermore, depending on time of measurement, scale body weight may not give good indication of the actual body mass of an animal, since it is a function of both gut fill and actual biological mass. The only constraint is that of

relative errors due to the measurer.

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