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Interrelationship between Body Weight and Body Size Parameters in Chinchilla and New Zealand White Rabbit Genotypes in Abeokuta, Nigeria

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Abstract
Traits of economic importance in rabbit when measured provide attributes that may be used as selection criteria by livestock breeders. This study was carried out to determine the interrelationship between body weight and body size parameters and to develop linear equations for predicting body weight using some body size parameters in two rabbit genotypes. Chinchilla and New Zealand White rabbit genotypes were selected for this study, with each breed having 20 does and 4 bucks making a total of 48 rabbits (precisely breeders). The animals were intensively managed and body weight, body length, ear length, heart girth, head length and tail length were measured on weekly basis. Body size parameters were correlated and regressed with body weight of each genotype and results were compared. At the end of the twelve-week study period, body weights were 2.074±0.280 kg and 2.130±0.240 kg for Chinchilla and New Zealand White rabbit genotypes, respectively. Body size parameters considered were positively correlated with body weight for both genotypes. Ear length, heart girth and head length only were significantly ($P < 0.01$) correlated with body weight for Chinchilla, while body size parameters were found to be significantly ($P < 0.01$) correlated with body weight for New Zealand White rabbit. Linear equations were developed for predicting the body weight from these body size parameters in each genotype. We observed that heart girth proved to be the best predictor for body weight in New Zealand White and Chinchilla rabbit genotypes, having a coefficient of determination (r^2) of 0.529 and 0.547, respectively.
Keywords: Body dimensions, Breeds of rabbit, Bucks, Does, Prediction, Selection criteria

1. Introduction

Rabbits are small long-eared mammals belonging to the family *Leporidae.* Rabbit, a micro livestock possesses the following important attributes; small body size, ability to utilize less competitive feeds, short generation interval, rapid growth, potentials for genetic improvement and production of high quality meat and useful by-products. With the increase in human population especially in developing country like Nigeria, the supply of enough animal protein from the major livestock species or the 'big five' (cattle, sheep, goats, swine and poultry) had become impossible, hence the interest in micro livestock such as rabbit because its production has enormous potential in alleviating the problem of animal protein supply in developing economy according to Cheeke (1986); Biobaku and Dosunmu (2003); Fayeye and Ayorinde (2003).

In South-West Nigeria, three rabbit breeds available in most farms are the Giant Flemish, Chinchilla and Rex. Other breeds of rabbit found in some well-organized farms in this part of the country include the New Zealand White and Californian White according to Olowofeso *et al.* (2012). In Abeokuta, the Ogun State capital, two rabbit genotypes in which their productive and breeding potentials have been of interest to livestock breeders are the New Zealand White and Chinchilla rabbit genotypes and there is therefore the need to have information about some measurable traits in these animals for effective breeding plan programmes. Body size and body conformation or types are important criteria for judging market livestock. The easiest way to assess an animal's body mass is to weigh the animal. However, under some situations, scale may not be readily available and prediction of body weight from body measurements could be preferred (Latshaw and Bishop, 2001).

Body measurements differ according to factors such as breed, gender, yield type and age. Some common measurable traits often considered in rabbits are the head length, body length, heart girth, ear length and tail length. The objectives of this study are to determine the interrelationship between body weight and body size parameters and to develop linear equations for predicting body weight using some body size parameters in Chinchilla and New Zealand White rabbit genotypes in Abeokuta, Ogun State, Nigeria.

2. Materials and Methods

2.1 Experimental Site

This study was carried out at the Rabbit Breeding Unit, Directorate of University Farms, (DUFARMS), Federal University of Agriculture, Abeokuta, Nigeria. The University is located on latitude $7^0$10'N and longitude $3^0$2'E and lies in the Southwestern part of Nigeria. Mean annual rainfall is about 1037 mm and mean monthly ambient temperature ranged from 28ºC in December to 36ºC in February with a yearly average relative humidity of about 82%. The vegetation represents an interphase between the tropical rainforest and the derived savannah (Jegede *et*

al., 2015).

2.2 Management of Parent Stock

Two rabbit genotypes selected for this study are the New Zealand White (NZW) and Chinchilla (CH), twenty (20) does of each genotype and four (4) bucks of NZW and CH, making a total of forty eight (48) rabbits were used. They were breeders aged between 7 and 9 months, all procured from reputable Livestock Farm in Ogun State, Nigeria. In order to achieve ideal production and good results, the rabbits were intensively managed and data were collected on weekly basis for 12 weeks. The rabbits were fed *ad libitum* with concentrate (layers mash) and roughages which included *Aspilia africana, Euphobia heterophyla* and *Calapogonium mucunoides*. Clean water was supplied *ad libitum*. Adequate sanitation and disinfection of the hutches a week before the arrival of the rabbits was carried out to prevent occurrence of diseases. Antibiotics (vitalyte) were also given to the rabbits on arrival. Rat holes were completely blocked and surroundings were kept clean throughout the experimental period.

2.3 Measurable Traits Considered in Both Rabbit Genotypes

In addition to the body weight (BW) of each of the animal, obtained using sensitive weighing scale, five linear body size parameters were measured from each animal with a tailor tape graduated in centimetre. The five body size parameters were head length (HL), body length (BL), heart girth (HG), ear length (EL) and tail length (TL).

2.4 Statistical Analysis

A single measure of location (i.e. mean) and single measure of dispersion (standard deviation) were calculated for the measured traits in both rabbit genotypes. Data on body weight and five body size parameters obtained from both rabbit genotypes were further subjected to analysis using Pearson's product moment correlation coefficient and regression analyses embedded in SAS (2003) version 9.1.3. Simple prediction model used was of the form: $Y = a + bX + e$, where Y = body weight, X = independent variables (BL, EL, HG, HL and TL), a = intercept, b = slope of the regression and e = random error term.

3. Results and Discussion

Using the data generated for body weight and the five linear body measurements from the two rabbit genotypes, descriptive statistics were carried out. The mean body weight for Chinchilla and New Zealand White were 2.074 and 2.130 kg, respectively. For the body size parameters (BL, EL, HG, HL and TL) the values obtained were 35.930, 10.971, 27.576, 12.943 and 8.333 cm for Chinchilla rabbit and were 35.210, 10.522, 27.399, 12.490 and 8.218 cm for New Zealand White rabbit, respectively. These means for body weight and linear body measurements in the rabbits are presented in Table 1.

In all the body size parameters for both rabbit genotypes, tail length (TL) had the smallest mean value, moderate for heart girth (HG) and the highest value was observed in body length (BL). Chinchilla rabbit showed higher mean values in all the body size parameters, but low mean body weight compared to the New Zealand White rabbit genotype, this showed that both rabbit genotypes can be selected by livestock breeders for meat purpose, that is when higher body weight is trait of priority, New Zealand White rabbit is preferred and when body size conformations are traits of interest, the Chinchilla is recommended. These results are in line with that of Okoro *et al.* (2010).

In the Chinchilla rabbit genotype, body weight (BW) showed a positive and significant correlation and it ranged from 0.033 to 0.739 in all the body size parameters, except for body length and tail length with body weight, which showed low correlation values ranging from 0.033 (TL vs. BW) to 0.114 (BL vs. BW). The New Zealand White rabbit genotype has a positive and significant ($P<0.05$) correlation coefficient for the body size parameters and values ranged from 0.374 to 0.727, with heart girth versus body weight having the highest correlation coefficient of 0.727, and body length versus body weight was the least with value of 0.374. Selection for any of these traits that are positively and significantly correlated with body weight will lead to an improvement in the meat quality of these rabbit genotypes as previously reported by Chineke (2000); Tiamiyu *et al.* (2000); Akanno and Ibe (2006).

Pearson correlation matrices between body weight and five linear body parameters are summarised in Table 2. Prediction equations developed for the body weight of Chinchilla and New Zealand White rabbit genotypes are presented in Table 3. In Chinchilla rabbit, coefficient of determination (r^2) ranged from 0.001 to 0.547. The most reliable estimate was given by heart girth (HG) which has the highest coefficient of determination ($r^2 = 0.547$), while a low coefficient of determination was observed in the other body size parameters. The highest coefficient of determination (r^2) observed in heart girth is in line with the findings of Heinrichs *et al.* (1992) that reported that the heart girth was one of the greatest body weight predictors. Also, in the New Zealand White rabbit, the coefficient of determination (r^2) among the traits measured ranged from 0.140 to 0.529 with heart girth having the highest value of 0.529, while the other body size parameters (BL, EL, HL

and TL) had a low coefficient of determination. The high value for prediction of body weight (BW) by heart girth (HG) compare to other body size parameter is in agreement with the report of Chineke (2000).

The low value for coefficient of determination observed in the other body size parameters, especially tail length in Chinchilla rabbit genotype could be due to genetic ceiling of some body parts after a certain age in life as reported by Ebegbulem (2012). According to Ozoje and Mgbere (2002); Salako and Mgbere (2002), the final body weight of an animal reflects the total weight of its component parts, therefore, prediction equation provide a readily available tool in estimating body weight especially in rural communities and in areas where standard weighing scales or balances are lacking.

4. Conclusion

The study shows that under standard management system of rabbit production, as the body weight increases, so also the body dimensions increases especially those considered in this study. The body weight and five body size parameters in both rabbit genotypes were positively correlated. The five simple linear equations developed using the body size parameters as independent variables can be used to predict body weight of rabbit genotypes. Novel information of this study is that to accurately predict the body weight of rabbits using body size parameters, heart girth appeared to be the best trait that can be used among the five traits considered in this study.

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Table 1. Mean and standard deviation, minimum and maximum value of body weight and body size parameters in Chinchilla and New Zealand White rabbit genotypes*

Trait	Rabbit genotypes		Minimum/Maximum value for each each genotype	
	CH ($\bar{X} \pm \sigma$)	NZW ($\bar{X} \pm \sigma$)	CH	NZW
BW (kg)	2.074±0.281	2.130±0.237	1.600/2.680	1.500/2.550
BL (cm)	35.983±1.398	35.210±1.107	33.800/40.000	32.800/37.600
EL (cm)	10.971±0.913	10.522±1.205	8.100/12.400	6.400/11.900
HG (cm)	27.576±2.169	27.399±1.592	24.000/30.400	24.500/30.500
HL (cm)	12.943±0.497	12.490±0.745	11.800/14.000	10.900/13.600
TL (cm)	8.333±0.503	8.218±0.693	7.000/9.700	6.500/9.500

** Abbreviations were as defined within text.*

Table 2. Correlation coefficient between body weight and body size parameters in Chinchilla (above diagonal) and in New Zealand White rabbit genotypes (below diagonal)

Trait	BL	EL	HG	HL	TL	BW
BL (cm)	****	0.542**	0.108	0.271**	0.130	0.114
EL (cm)	0.154	****	0.434**	0.392**	0.445**	0.342**
HG (cm)	0.393**	0.448**	****	0.328**	0.010	0.739**
HL (cm)	0.051	0.082	0.031	****	0.396**	0.392**
TL (cm)	0.064	0.062	0.307**	0.590**	****	0.033
BW (kg)	0.374**	0.542**	0.727**	0.482**	0.497**	****

*** Correlation is significant at the 0.010 level (2-tailed).*

Table 3. Simple linear equations developed for body weight and body size parameters in Chinchilla and New Zealand White rabbit genotypes in Abeokuta, Nigeria*

Body size parameter (cm)	Genotype	Developed linear equations	r^2
BL	CH	BW = 1.253 + 0.023BL	0.013
	NZW	BW = -0.687 + 0.080BL	0.140
EL	CH	BW = 3.227 – 0.105EL	0.117
	NZW	BW = 1.010 + 0.106EL	0.293
HG	CH	BW = -0.564 + 0.096HG	0.547
	NZW	BW = -0.832 + 0.108HG	0.529
HL	CH	BW = -0.793 + 0.222HL	0.154
	NZW	BW = 0.218 + 0.153HL	0.232
TL	CH	BW = 2.228 – 0.019TL	0.001
	NZW	BW = 0.735 + 0.170TL	0.247

**Abbreviations were as defined within text.*