ESTIMATION OF MORPHOMETRIC TRAITS OF PURE, MAIN AND RECIPROCAL RABBIT CROSSES USING ALLOMETRIC EQUATION

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ABSTRACT
A base population consisted of 9 sires mated to 27 dams in a Completely Randomized Design was used in the production of the F_1 progenies for the determination of the effect of genotype on growth characteristics of rabbit crosses in a humid tropical environment. The rabbits consisted of 9 each of Chinchilla, New Zealand White and Dutch does and 3 bucks for each of the genotypes. The data from the study were used to evaluate the allometric growth equation and distribution coefficients for linear growth parameters for 12 week period in pure, main and reciprocal rabbit crosses. The allometric coefficients showed that thigh girth, tail length and heart girth grew fast in the crossbred than the purebred rabbits. NZW x CHA had allometric coefficients of 0.37 and 0.46 for heart girth and tail length, 0.40 and 0.47 in NZW x DUT. CHA x DUT had allometric coefficients of 0.47, 0.40 and 0.44 for heart girth, thigh girth and tail length, 0.35, 0.40 and 0.46 for CHA x NZW, 0.38, 0.48 and 0.42 in DUT x CHA and 0.39, 0.43 and 0.43 in DUT x NZW. Importance of thigh girth and heart girth as a major meat cut regions is also associated with higher body weight. With the superiority of NZW x CHA in terms of body weight and most linear body measurements, it is therefore concluded that the NZW x CHA rabbits should be used for growth purposes and that linear body measurements can be used as indicators of body weight.

Keywords: **Morphormetric Traits,Rabbits Genotypes, Allometric Growth, Phenotypic Correlation.**

INTRODUCTION

Allometric growth is the growth of different body parts at different rates while the growth of different body part in equal proportion is known as isometric growth Cardoso and Negreiros- Fransozo, (2004). Mendes (2008) stated that organs of animals with good genetic structure and reared in favorable environmental condition are expected to have equal growth on both body sides. The allometric growth of species can be designed by estimating the live weight of individual from the length (Tomanova *et al*., 2010). The allometric growth is an essential element for the management of animal resources but also a tool to guide the selection of animals for rapid growth. The objective of this work was to estimate the allometric growth pattern of rabbit crosses reared in the humid tropics.

MATERIALS AND METHODS

A total of 36 mature rabbits were used as the base population for the study. The rabbits were purchased from Akwa Ibom State, Nigeria and were reared in the Rabbitry Unit of Credo Farms in Abak L.G.A., Akwa Ibom State. The area lies within the rain forest zone of Nigeria. The rabbits consist of nine (9) each of Chinchilla, New Zealand White and Dutch does and three (3) bucks for each of the genotypes. The animals were housed in hutches, allowed to mate naturally and kindle. Clean drinking water and feed was served *ad libitum*. The diet fed to the animals consisted of 18% CP, 2600 ME (Kcal/kg) and 8% CF. Forages-*Panicum maximum* and *Centrosema pubescens* was also be provided.

The weight was taken using a sensitive scale with sensitivity of 25g and a top loading Hana power 5 kg scale, Ear length (EL) was measured from the base to the tip of the ear, Body length (BL) was taken from the middle of the head to the base of the tail, Heart girth (HG) was taken by measuring the circumference of the chest region, Thigh girth (TG) was taken by measuring the circumference of the thigh region, Length of forelimb was measured from the base of the ulna bone to the tip of the feet, Head-to-shoulder (HS) was measured from the head to the shoulder, Tail length (TL) was measured

from the base to the tip of the tail. All parameters were measured bi-weekly using meter rule and tailor's tape calibrated in cm. The data were used to determine the Log linear and allometric growth equation and distribution coefficients for linear growth parameters for 12 week period in rabbit crosses.

Allometric growth equation for the data on body weight (BWT) and linear body measurements (Y) is given in the expression below;

$Y = \alpha W^{\beta}$

Where;

Y= Linear body measurement eg KL, SL, BL etc

W = Body weight

α = Initial growth constant

β = Coefficient of allometry

Least square estimates of α and β were obtained by fitting the log-transformed linear equation in expression (5) (Ibe and Nwakalor, 1987).

$Log_{10}Y = Log_{10}\alpha + \beta\ Log_{10}W$

According to Ibe and Nwakalor (1987), α is numerically determined by;

$\acute{\alpha}$ = antilog (logY – β logW)

The coefficient, β is equivalent to $\frac{(\log Y - \log \alpha)}{\log W}$

The various coefficients of allometry were compared with the coefficient of isometric growth (0.33), which is an indicator of equal rate of growth between any component part and the body as a whole (Cock, 1963).

RESULTS AND DISCUSSION

Tables 1, 2 and 3 show the log linear and allometric growth equation and distribution coefficients for linear growth parameters for 12 week period in pure bred, main and reciprocal crossbred rabbit. In NZW x NZW, thigh girth and tail length had high allometric coefficients of 0.38 and 0.47, respectively. The thigh and tail grew faster than other components; the ear length, body length, heart girth and head-to-shoulder had low allometric coefficients of 0.31, 0.28, 0.31 and 0.27 respectively, which showed that they grew slower compared with the entire body. In CHA x CHA, the ear length and heart girth grew fast, while thigh length

Table 1: Log linear and allometric growth equation and distribution coefficients for linear growth parameters for 12 week period in pure bred Rabbit Genotypes

Genotype	Linear parameter	Log-linear	R^2	S.E	Allometric
NZW x NZW	Ear length	Y = 0.08 + 0.31BWT	85	0.07	$1.20(BWT)^{0.31}$
	Body length	Y = 0.58 + 0.28BWT	83	0.07	$3.80(BWT)^{0.28}$
	Heart girth	Y = 0.39 + 0.31BWT	75	0.10	$2.45(BWT)^{0.31}$
	Thigh girth	Y = -0.09 + 0.38BWT	95	0.05	$0.81(BWT)^{0.38}$
	Head-to-shoulder	Y = 0.51 + 0.27BWT	50	0.09	$3.24(BWT)^{0.27}$
	Tail length	Y = -0.42 + 0.47BWT	84	0.11	$0.38(BWT)^{0.47}$
CHA x CHA	Ear length	Y = 0.00 + 0.34BWT	85	0.08	$1.00(BWT)^{0.34}$
	Body length	Y = 0.58 + 0.28BWT	84	0.07	$3.80(BWT)^{0.28}$
	Heart girth	Y = 0.29 + 0.35BWT	78	0.10	$1.95(BWT)^{0.35}$
	Thigh girth	Y = -0.10 + 0.38BWT	93	0.06	$0.79(BWT)^{0.38}$
	Head-to-shoulder	Y = 0.54 + 0.25BWT	59	0.07	$3.46(BWT)^{0.15}$
	Tail length	Y = -0.48+ 0.49BWT	85	0.12	$0.33(BWT)^{0.49}$
DUT x DUT	Ear length	Y = -0.08 + 0.37BWT	84	0.09	$1.82(BWT)^{0.37}$
	Body length	Y = 0.51 + 0.31BWT	85	0.07	$0.54(BWT)^{0.31}$
	Heart girth	Y = 0.47 + 0.30BWT	91	0.05	$1.23(BWT)^{0.30}$
	Thigh girth	Y = -0.21 + 0.42BWT	94	0.06	$0.63(BWT)^{0.42}$
	Head-to-shoulder	Y = 0.32 + 0.24BWT	78	0.07	$2.09(BWT)^{0.24}$
	Tail length	Y = -0.46 + 0.49BWT	81	0.13	$0.33(BWT)^{0.49}$

and tail length grew faster than the entire body, having 0.38 and 0.49 as the coefficients of allometry. The body and head-to-shoulder grew slower than the other body components. In DUT x DUT, the ear length grew slightly faster proportionally with the coefficient of allometry of 0.37, body length, heart

girth and head-to-shoulder grew slower when compared to the entire body having coefficients of allometry of 0.31, 0.30 and 0.24, respectively.

In table 2, NZW x CHA, with the exception of heart girth, thigh length and tail length, the body components grew slower as showed by their low coefficients of allometry of 0.27, 0.29 and 0.20 (for ear length, body length and head-to-shoulder, respectively). In NZW x DUT, the ear, body and head-to-shoulder grew slower proportionally with the coefficient of allometry of 0.28, 0.30 and 0.27, respectively. Thigh showed equal proportion in growth with the entire body with the coefficient of 0.34 while heart and tail grew faster when compared to the entire body having coefficients of allometry of 0.40 and 0.47, respectively. In CHA x DUT, head-to-shoulder grew slower as showed by the low coefficients of allometry of 0.22, ear and body length have coefficients of allometry of 0.34 and 0.33 which showed equal proportional growth with the entire body while heart, thigh and tail grew faster than the other body components having the coefficients of allometry of 0.47, 0.40 and 0.44.

Table 2: Log linear and allometric growth equation and distribution coefficients for linear growth parameters for 12 week period in Main Crossbred Rabbit Genotypes

Genotype	Linear parameter	Log-linear	R^2	S.E	Allometric
NZW x CHA	Ear length	Y = 0.20 + 0.27BWT	83	0.07	$1.58(BWT)^{0.27}$
	Body length	Y = 0.58 + 0.29BWT	83	0.07	$0.69(BWT)^{0.29}$
	Heart girth	Y = 0.19 + 0.37BWT	68	0.14	$1.55(BWT)^{0.37}$
	Thigh girth	Y = -0.01 + 0.35BWT	87	0.07	$0.98(BWT)^{0.35}$
	Head-to-shoulder	Y = 0.41 + 0.20BWT	75	0.06	$2.57(BWT)^{0.20}$
	Tail length	Y = -0.39 + 0.46BWT	86	0.10	$0.41(BWT)^{0.46}$
NZW x DUT	Ear length	Y = 0.15 + 0.28BWT	80	0.08	$1.41(BWT)^{0.28}$
	Body length	Y = 0.47 + 0.30BWT	82	0.08	$5.89(BWT)^{0.30}$
	Heart girth	Y = 0.18 + 0.40BWT	85	0.09	$3.80(BWT)^{0.40}$
	Thigh girth	Y = -0.01 + 0.34BWT	91	0.06	$2.14(BWT)^{0.34}$
	Head-to-shoulder	Y = 0.20 + 0.27BWT	57	0.07	$1.58(BWT)^{0.27}$
	Tail length	Y = -0.44 + 0.47BWT	85	0.11	$1.07(BWT)^{0.47}$
CHA x DUT	Ear length	Y = -0.11 + 0.34BWT	71	0.11	$0.78(BWT)^{0.34}$
	Body length	Y = 0.43 + 0.33BWT	87	0.07	$5.75(BWT)^{0.33}$
	Heart girth	Y = -0.01 + 0.47BWT	78	0.13	$0.98(BWT)^{0.47}$
	Thigh girth	Y = -0.16 + 0.40BWT	91	0.07	$0.69(BWT)^{0.40}$
	Head-to-shoulder	Y = 0.65 + 0.22BWT	52	0.06	$4.47(BWT)^{0.22}$
	Tail length	Y = -0.52 + 0.44BWT	81	0.13	$0.30(BWT)^{0.44}$

In table 3 CHA x NZW, ear and body length showed equal proportional growth with coefficients of allometry 0.32. Heart girth grew fast, having the coefficients of allometry of 0.35 while thigh and thigh grew faster with coefficients of 0.40 and 0.46, respectively. Head-to-shoulder grew slower than the other body components having a coefficient of 0.25. Isometric growth was seen in ear length of DUT x CHA, body and head-to-shoulder grew slower than the other body components (0.30 and 0.20, respectively), body grew fast with coefficients of allometry of 0.38 while thigh and tail grew faster having allometry coefficients of 0.48 and 0.42, respectively. In DUT x NZW, the ear, body and head-to-shoulder grew slower as showed by the coefficients of allometry of 0.29, 0.30 and 0.23. Heart girth grew fast (0.39) while thigh and tail length grew faster with coefficients of allometry of 0.43. DUT x NZW had the least R^2 value of 41% for the equation relating body weight and Head-to-shoulder.

The high R^2 values obtained by the genotypes suggest that data for growth performance of different body parts of turkeys with respect to each other and the whole body could be achieved by the prediction of allometric growth parameters (Sørensen *et al*., 2003; Abanikannda and Leigh, 2007). Ibe and Nwakolor (1987) stated that differences in relative growth between the two genotypes with respect to certain structural parameters possibly reflect difference in the frequencies of genes which produce hormones and enzymes required for the physiological synchronization of growth of these structures. Chineke (2006) reported that differences in linear traits reveal useful measures that depict the size and shape of an animal.

Table 3: Log linear and allometric growth equation and distribution coefficients for linear growth parameters for 12 week period in Reciprocal Crossbred Rabbit Genotypes

Genotype	Linear parameter	Log-linear	R^2	S.E	Allometric
CHA x NZW	Ear length	Y = 0.03 + 0.32BWT	76	0.10	$1.07(BWT)^{0.32}$
	Body length	Y = 0.42 + 0.32BWT	84	0.08	$2.63(BWT)^{0.32}$
	Heart girth	Y = 0.26 + 0.35BWT	63	0.15	$1.82(BWT)^{0.35}$
	Thigh girth	Y = -0.18 + 0.40BWT	90	0.07	$0.66(BWT)^{0.40}$
	Head-to-shoulder	Y = 0.54 + 0.25BWT	65	0.06	$3.47(BWT)^{0.25}$
	Tail length	Y = -0.55 + 0.46BWT	78	0.15	$0.28(BWT)^{0.46}$
DUT x CHA	Ear length	Y = 0.00 + 0.33BWT	73	0.11	$1.00(BWT)^{0.33}$
	Body length	Y = 0.49 + 0.30BWT	80	0.08	$3.09(BWT)^{0.30}$
	Heart girth	Y = 0.20 + 0.38BWT	70	0.14	$1.58(BWT)^{0.38}$
	Thigh girth	Y = -0.35 + 0.48BWT	73	0.16	$0.45(BWT)^{0.48}$
	Head-to-shoulder	Y = 0.37 + 0.20BWT	68	0.08	$2.34(BWT)^{0.20}$
	Tail length	Y = -0.60 + 0.42BWT	84	0.13	$0.25(BWT)^{0.42}$
DUT x NZW	Ear length	Y = 0.13 + 0.29BWT	82	0.08	$1.35(BWT)^{0.29}$
	Body length	Y = 0.48 + 0.30BWT	82	0.08	$3.02(BWT)^{0.30}$
	Heart girth	Y = 0.16 + 0.39BWT	59	0.18	$1.45(BWT)^{0.39}$
	Thigh girth	Y = -0.35 + 0.43BWT	77	0.15	$0.45(BWT)^{0.43}$
	Head-to-shoulder	Y = 0.59 + 0.23BWT	41	0.08	$3.63(BWT)^{0.23}$
	Tail length	Y = -0.44 + 0.43BWT	87	0.11	$0.36(BWT)^{0.43}$

CONCLUSION AND RECOMMENDATION

Allometry explains the association between dimensions of organisms and changes in the relative proportions of these dimensions with change in total size. The allometric equations showed significant association between body weight and linear body parameters. The allometric coefficients revealed that tail length, thigh length and heart girth length grew fast in all the genotypes, which implies that for any unit increase in body size, there was a proportional larger increase in the size of the tail, thigh and heart. This study showed that crossbreeding is crucial in the improvement of rabbits for the traits studied.

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