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EFFECT OF WEANER BODY WEIGHT ON GROWTH TRAITS OF RABBITS

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ORIGINAL ARTICLE

ABSTRACT: *Data from growth parameters and production traits of 108 ten-week old male rabbits comprising Newzealand white, Dutch and Chinchilla breeds collected over a period of 16 weeks were analysed in a 2- factor factorial in a randomised complete block (RCBD) to determine their interrelationships and response to age and weaner body weight groupings as a step towards employing them in selection and breeding programme and predicting live body weight. Individual breeds were grouped into three categories of body weights of low (LBW), medium (MBW), and high (HBW), depending on the body weight range of each breed. The linear body parameters were characterised using Body weight (BW), Heart girth (HG), Shoulder to tail drop, Head to shoulder, Ear length and Tail length, while the Production traits studied were average Daily feed intake, Feed conversion efficiency and mortality. Results of the analysis evinced significant (P<0.01) effect of breed-body weight interaction on the Production traits and linear body parameters studied. High weaner body weight Chinchilla consumed more feed; converted feed to meat more efficiently, gained weight more rapidly and recorded no mortality. Regression and correlation studies revealed that any one of the linear body traits could predict the rabbit body, weight at 20 weeks of age. Trait combination revealed that Ear length Vs Height at withers (R2-0.944), Ear length Vs Heart girth (R2-0.969) and Heart girth (R2= 0.935) best contributed to the total variability in body weight of Newzealand white Dutch and chinchilla respectively.*

Keywords: Weaner, body weight, growth traits and rabbits

INTRODUCTION

The problem of inadequate supply of animal protein from conventional sources like sheep, goat and chicken has led to the search for other sources of animal protein. The rabbit has been seen to be suitable in this regard. This is attributed largely to the rabbit's high rate of reproduction, early maturity, rapid growth rate, efficient food utilization and high quality nutritive value (Chineke 1996). Improvement of economic characters in animals requires estimates of genetic, environmental and phenotypic parameters for the various traits of interest. In order to achieve this goal, proper measurement of growth traits on important economic characters is required.

Body weight is regarded as a function of framework or size of the animal and its condition (Philip 1990). Variation in body weight within a flock can be attributed to genetic variation and environmental factors that impinge on individual (Ayorinde and Oke 1995). Body weight is known to be moderately to highly heritable and hence the selection of heavier individuals in a population should result in genetic improvement of the traits. Post weaning viability at different ages up to 16 weeks of age is significant in the economics of rabbit production. It has an important influence on the number of marketable rabbits and can be used in selection programmes for increasing productive efficiency (Afifi and Emara 1988). The study was therefore carried out to determine the effect of weaner body weight on production traits of rabbits as a step towards employing them as a correction factors in body weight estimation for selection purposes.

MATERIAL AND METHODS

The experiment was carried out at the Rabbitry unit of Michael Okpara University of Agriculture, Umudike Abia State, Nigeria. The university lies within the tropical rainforest belt of Nigeria. The area is located, on latitude 05^0 29N, Longitude 07^{0}33E and altitude of 122m above sea level. The daily mean temperature is 24.2^{0c}. The fluctuation is usually of wide variation, especially during the day although the nights are generally cooler. The zone

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has a maximum daily temperature of about 33^{0}c. The annual rainfall is about 2100 to 2500mm. The mean relative humidity is about 85%, although, daily values are usually liable to wide variation.

One hundred and eight 10-week old male rabbits of different breeds raised intensively were used for the study. The breeds were Newzealand white, Dutch and chinchilla. The three breeds were obtained from a total of 54 pure breeding does and 12 adult bucks, consisting of 18 New Zealand white, 16 Chinchilla, 20 Dutch and 4 bucks each of the three breed respectively and were used to produce 108 kits from 4 litters. Individual breeds were grouped into three categories of body weights of low (LBW), medium (MBW) and high (HBW0, depending on the body weight range of each breed. The rabbits were reared in individual pens, fed a concentrate ration of 19 percent crude protein, given free choice and supplemented with Panicum maximum and Centrosema pubescens. Fresh clean water was also supplied regularly.

Data collection and Statistical analysis

Records of feed intake, average daily gain and mortality were kept. Body linear measurements were determined using a tape rule. The ear length was taken as the length from the base of the ear to the tip,
Heart girth-circumstances of the body measured behind the forelimbs round the chest, Height at withers –vertical height at resting position, Head to shoulder-horizontal joining head to shoulder, Shoulder to tail drop- length from shoulder to the base of the tail, Tail length-length from shoulder to the tail end.

The experimental design adopted was 2-factor factorial in randomised complete block (RCBD). The factors were body weight (low, medium, high) and the genotype (Newzealand white, Dutch and chinchilla), while the age of the rabbits served as the block. The data obtained were subjected to analysis of variance using the model

$$Y_{ijkl} = \mu + A + G_j + W_k + (GW)_{jk} + e_{ijke}$$

Where Y_{ijkl} a single observation

A_i	=	effect of the i^{th} age
G_j	=	effect of j^{th} genotype (Chinchilla, Dutch, New Zealand white)
W_k	=	effect of the j^{th}, k^{th}/genotype
μ	=	overall mean
$e_{ijk}l$	=	random error

Pearson's correlation among the various body measurements were estimated and significant test carried out. Simple regression of the body traits on age was conducted using the model

y = $a+b_{xi} + e_i$
a = constant
b = regression coefficient i.e. change in the dependent variable (body trait) resulting from a unit change in the independent variable X_1 (age)
e_i, = random error

A stepwise regression analysis was carried out, using the model.

$$a+b_1x_1+b_2x_{2+}b_3x_3 + b_4x_{4-+}b_nx_n — + e_i$$

where

BW = body weight
a = constant
b,b,2 – b_nX_n = regression coefficient for traits X_1X_2—X_n respectively
e = error

The SPSS (1999) package was used for all statistical analysis.

RESULT AND DISCUSSION

The daily intake, feed efficiency, average daily body weight gain was significantly ($P<0.01$) different for the various genotype-body weight class interaction (Table 1). This result explains that breed-type-body weight class differences have significant effect on feed intake average daily body weight gain and feed efficiency. Thus, the rabbit of low body weight consumed the least daily, gained weight less readily and least converted feed to meat efficiently compared to the rabbit of higher body weight in all the breeds. The result also shows that the chinchilla gave the highest values for these traits. This could be explained by the fact that it is a heavy breed and thus benefits from the advantages posed by the established positive relationship between body weight and feed intake, feed efficiency and average daily gain. Buttressing this assertion, Ayorinde and Oke (1995), reported that the metabolic size of the animal is an important function of the animal appetite and therefore influences the total amount of feed consumed by the animal, thus the larger the animal the higher the feed intake. Burn and Ouhaoun (1981), confirmed that the Fleming giant crossbred litters of rabbits which consumed more feed, gained more rapidly and utilized feed more efficiently and weighted more at 70-day market weight when compared to the Newzealand white sired litters which consumed less feed and thus achieved slower gain, converted feed to gain less efficiently and consequent had the numerically lowest mean market weight at the same age. Ayorinde (1997) observed that the initially higher pre-wearing body weights of the Dutch and Newzealand white gave them an advantage to 18 weeks of age.

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Table 1 - Means of the FI, ADG, FE and MORT for the various genotype-body weight interactions

Genotype	Body weight class	Daily fed intake (g)	Average Daily weight Gain (g)	Feed efficiency	Mortality %
Newzealand White	LBW	41.136±0.907[a]	8.619±0.310[a]	4.842±0.44[c]	3.3
	MBW	52.789±0.907[b]	12.771±0.310[b]	4.141±0.044[b]	--
	HBW	54.809±0.907[c]	13.579±0.310[c]	4.052±0.044[a]	--
	LBW	53.150±0.907[a]	12.326±0.310[a]	4.344±0.044[c]	--
Dutch	MBW	60.244±0907[b]	14.857±0.310[b]	4.064±0.044[b]	--
	HBW	66.006±0.907[c]	17.365±0.310[c]	3.806±0.044[a]	--
	LBW	54.561±0.907[a]	13.619±0.310[a]	4.09710.044[c]	--
Chinchilla	MBW	66.944±00.907[b]	17.793+0.310[b]	3.780±0.044[b]	--
	HBW	80.978±1.283[c]	22.857±0.438[c]	3.553±0.063[a]	--

[a,b,c] means in the same column and with different subscripts are significantly different at P<0.01. MBW: Medium body weight. LBW: Low body weight. HBW: High body weight

The finding in this work recorded 3.3% mortality for the low body weight Newzealand white. This mortality could be explained by the fact that the rabbit possessed low body weight and thus consumed less feed daily, gained less rapidly and consequently was more susceptible to adverse environmental condition like infection.

Thus, the heavy breeds and weaners of higher body weights are most recommend for selection and breeding. The effect of the genotype-body weight class interaction on the linear body measurement was significantly (P< 0.01) different as shown in table 2. The findings in this work explains that rabbits that possessed initially low body weight did not perform as much as those of initially high body weight in terms of final body weight and linear body traits. The result also revealed that the heavy breed (chinchilla) recorded the highest values for the final body weight and linear body traits at 20 weeks of age, while the Newzealand white (LBW) recorded the lowest values for the final body weight and linear trait at the same age. This finding corroborates the work of Thomas and Nandakumar (2001) who asserted that the chinchilla, which possessed the highest body weight, had the highest values of the linear body traits. Explaining this, Roberts, (1963), added that there is a moment-by-moment increase on percentage basis on the existing body weight of the individual animal. This will mean that a positive correlation is existed between body weight and linear body measurement, thus selection of any of the body measurements for improvement would mean a concomitant improvement on the body weight. This suggests that choosing rabbits of increased linear body measurement would imply choosing for heavier body weights.

Results show that the correlation among linear measurement in Newzealand white rabbits is positively very high and significant (P<0.01) (Table 3). The correlation matrix showed live weight was significantly (P<0.01) and positively correlated with body length (0.818) tail length (0.865), head to shoulder (0.897), Height at wither (0.903), heart at girth (0.934) and ear length (0.958). This high correlation between live weight and heart girth has long been recognised in livestock and has been reported by Johanson and Hildeman (1954) who noticed a correlation of 0.97. From the results, ear length proved the best indicator of body size for the Newzealand white. The interrelationship among the linear traits reveals that body length (shoulder to tail drop) was most correlated to head to shoulder. This means that selection for improvement in the head to shoulder would mean increased body length and subsequent body size increase. This also implies that absolute length and head to shoulder are complementary.

The results also show that correlation among linear measurement and body weight in the Dutch were positive, high and significant (P< 0.01) (Table 4). The work of Lawrence and Fowler (1997) supported this assertion. Specifically, the matrix indicates the live weight was significantly (P<0.01) and positively correlated with heart girth (0.797), head to shoulder (0.872), tail length (0.898), body length (0.900), height at withers (0.947) and ear length (0.983). The result depicts ear length as the best predictor of body size. The result of the interrelationship among the linear traits show that body length and head to shoulder are most correlated (0.959). This would mean that improvement on head to shoulder would most increase body length. However, this disagree with the finding of Tiamiyu et al.,(2001) who observed that body length and heart girth were most correlated. (0.95). These deviation may be explained by the assertions of Ibe and Ezekwe (1994), who maintained that different linear body traits measurement would be required to quantify body shape and size in different breeds and under different conditions.

The correlation between body size and linear trait measurements in the chinchilla were positive, high and significant (P<0.01) (Table 5). The matrix reveals that body weight is significantly (P<0.01) and positively correlated with head to shoulder (0.888), body length (0.988), height at withers (0.902) tail length (0.92) ear length (0.952) and heart at girth (0.967). From the foregoing heart girth is the best predictor of body size in chinchilla. This assertion corroborates the findings of Tiamiyu et al (2000) and Johanson and Hilderman (1954). The results of interrelationship among the linear body traits show that body length and tail length (0.992) are best correlated. This indicates that absolute body length and tail length are complementary and this means that selection of heavy breed rabbits that are long in body and tail may be practicable. These features are thus indicator of good conformation.

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Table 2 - Means of the body linear traits for the genotype-body weight interaction

Genotype Trait	Body weight class	Body weight (g)	Tail length (cm)	Heart at girth (cm)	Ear length (cm)	Head to shoulder (cm)	Height at withers (cm)	Shoulder to tail drop (cm)
	LBW	1105.90±29.847^{a}	8.32±0.149^{a}	19.353±0.114^{a}	9.325±0.074^{a}	8.88±0.130^{a}	11.96±0.078^{a}	20.497±0.240^{a}
Newzealand	MBW	1467.75±29.847^{b}	11.57±0.149^{b}	21.28±0.114^{b}	10.016±0.074^{b}	10.70±0.130^{b}	12.69±0.078^{b}	23.284±0.240^{b}
	HBW	1517.75±29.847^{c}	12.24±0.149^{c}	21.81±0.114^{c}	10.524±0.074^{c}	11.66±0.130^{c}	13.34±0.078^{c}	24.890±.240^{c}
	LBW	1438.70±29.847^{a}	8.57±0.149^{a}	19.02±0.114^{a}	9.932±0.074^{a}	8.19±0.130^{a}	12.82±0.078^{a}	23.704±0.240^{a}
Dutch	MBW	1657.35±29.847^{b}	9.67±0.149^{b}	22.43±0.114^{b}	10.449±0.074^{b}	8.95±0.130^{b}	13.22±0.078^{b}	24.785±0.240^{b}
	HBW	1865.15±29.847^{c}	10.58±0.149^{c}	23.43±0.114^{c}	10.805±0.074^{c}	10.51±0.130^{c}	13.82±0.078^{c}	24.487±0.240^{c}
	LBW	1488.05±29.847^{a}	7.21±0.149^{a}	21.55±0.114^{a}	9.785±0.074^{a}	7.91±0.130^{a}	13.20±0.078^{a}	21.470±0.240^{a}
Chinchilla	MBW	1873.35±29.847^{b}	8.99±0.149^{b}	23.23±0.114^{b}	10.404±0.074^{b}	10.43±0.130^{b}	14.32±0.078^{b}	24.668±0.240^{b}
	HBW	2304.50±42.210^{c}	10.97±0.211^{c}	25.11±0.162^{c}	11.752±0.074^{c}	11.53±0.184^{c}	15.08±0.111^{c}	28.970±0.339^{c}

^{a,b,c} means in the same column and with different subscripts are significantly different at P<0.01.

Table 3 - Coefficients of the correlations between characters in Newzealand White

Parameters	Body Weight	Tail length	Heart girth	Ear length	Head to shoulder	Height at Withers
Tail length	0.865**					
Heart girth	0.934**	0.935**				
Ear length	0.95**	0.916**	0.957**			
Head to shoulder			0.918**	0.958**		
	0.897**	0.973**				
Height at withers	0.903**	0.941**	0.930**	0.979**	0.978**	
Shoulder to tail	0.818**	0.961**	0.850	0.903**	0.983**	0.950**

** Significantly different at P<0.01.

Table 4 - Coefficient of correlation between characters in Dutch

Parameters	Body Weight	Tail length	Heart girth	Ear length	Head to shoulder	Height at withers
Tail length	0.895**					
Heart girth	0.797**	0.907**				
Ear length	0.983**	0.926**	0.838**			
Head to shoulder	0.872**	0.956**	0.879**	0.882**		
Height at withers	0.947**	0.942**	0.871**	0.956**	0.952**	
Shoulder to tail	0.900**	0.950**	0.838**	0.916**	0.959**	0.931**

** Significantly different at P<0.01.

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Table 5 - Coefficient of correlation between characters in Chinchilla						
Parameters	**Body Weight**	**Tail length**	**Heart girth**	**Ear length**	**Head to shoulder**	**Height at withers**
Tail length	0.921**					
Heart girth	0.967**	0.966**				
Ear length	0.952**	0.916**	0.972**			
Head to shoulder	0.888**	0.967**	0.928**	0.841**		
Height at withers	0.902**	0.952**	0.956**	0.917**	0.925**	
Shoulder to tail	0.988**	0.992**	0.941**	0.888**	0.955**	0.913**

** Significantly different at P<0.01.

The magnitude of the coefficient of determination (R2) for each parameter in the regression equation show the relative contribution of each body measurement to the body weights of rabbits at 20 weeks of age. The results show that the coefficient of regression of the body traits on age is positive and significant for all the breeds (P<0.01). This is confirmed by the work of Chineke et al 2000, who reported a consisted increase in body measurements of rabbits with age. The three breeds revealed ear length as the best regressed on age and thus contributed most to body weight of the rabbits at 20 weeks of age. The ear length contributed 38.9, 59.6, and 42.7% to the body weight of the New Zealand white Dutch, and Chinchilla respectively at 20 weeks of age. However, heart girth contributed second best to body weight in New Zealand white (30.1%) and chinchilla (36.9%) at the same age. The stepwise regression of body weight on the various body linear traits (Tables 6 and 7) revealed that in the New Zealand white, 94.9% of body weight is attributable to ear length, height at withers and tail length at 20 weeks of age, while only 94.5% of body weight is attributed to ear length and height at withers. The combination of traits that gives the highest R^2 value depicts the best predictor of body weight. However, since both combinations contribute approximately the same (95%) to body weight variability, it would be most appropriate to select the combination that would enable ease measurement (Chineke 2000). Thus with the aid of regression equation involving ear length and height at withers they appropriate values could be substituted to obtain estimate of rabbit body weight for the age bracket reported in this work. The result on the Dutch breed show that the trait combination involving ear length, heart girth and height at withers contributed 97.1% to body weight while combination of ear length and heart girth contributed 96.1% to body weight.

Table 6 - Simple Regression equations for the different variables on age for the three genotypes of rabbits					
Body trait	**Genotype**	**Intercept (a)**	**Regression coefficient (b)**	**Coefficient of R^2**	**SE**
Body weight	NZW	81.245	0.743**	0.553	217.55
	Dutch	28.081	0.832**	0.693	204.166
	Chinchilla	-61.811	0.717**	0.514	343.44
Tail length	NZE	7.196	0.324**	0.105	1.937
	Dutch	6.300	0.533**	0.284	0.991
	Chinchilla	4.942	0.427**	0.183	1.495
Heart Girth	NZW	16.847	0.549**	0.301	1.139
	Dutch	16.865	0.423**	0.179	1.896
	Chinchilla	16.898	0.608**	0.369	1.492
Ear length	NZW	7.585	0.623**	0.389	0.560
	Dutch	7.664	0.772**	0.596	0.424
	Chinchilla	6.569	0.654**	0.427	0.845
Head of shoulder	NZW	6.912	0.420**	0.176	1.426
	Dutch	5.895	0.513**	0.263	1.048
	Chinchilla	5.853	0.422**	0.178	1.539
Height at withers	NZW	10.685	0.496**	0.246	0.654
	Dutch	11.199	0.659**	0.434	0.449
	Chinchilla	11.589	0.459**	0.210	0.894
Shoulder to tail drop	NZW	19.209	0.285**	0.081	2.358
	Dutch	19.299	0.614	0.376	1.381
	Chinchilla	18.029	0.377	0.142	2.889

SE= Standard Error. ** Significant at P<0.01

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Table 7 - Stepwise regression equations for estimating body weight at 20 weeks of age, using different combinations of linear body traits.						
Genotype	Step Trait	Intercept	Regression coefficient	Partial R^2	Model R^2	SE
New Zealand	1 Ear length	-2966.339	0.958	0.919	0.917	92.79
	2 Ear length	-2113.960	1.755	0.947	0.945	75.69
	Height at Withers	-	-0.814	--	--	--
	3. Ear length	-1400.271	1.778	0.951	0.949	72.98
	Height at Withers	--	-1.026	--	--	
	Tail length	--	0.202	--	--	--
Dutch	1 Ear length	-3990.328	0.983	0.966	0.966	67.501
	2 Ear length	-4079.025	1.056	0.969	0.968	65.743
	Height girth	--	-0.087			--
	3. Ear length	-4650.660	0.909	0.971	0.970	63.474
	Heart girth	--	-0.134	--	--	
	Height at Withers	--	0.195	--	--	
Chinchilla	1. Heart girth	-4009.619	0.967	0.935	0.933	125.97
	2. Heart girth	-3718.471	1.216	0.940	0.938	121.53
	Height at Withers	--	-0.260	--	--	--

SE= Standard Error

CONCLUSSION

Result on the chinchilla proved that two combinations would best predict body weight at 20 weeks of age. Combination of heart girth and height at withers contributed 94.0% variability in body weight. This also corroborates the findings of Chineke (2000), who reported very high association for heart girth, height at wither and body weight.

The results indicate that with the various breeds of rabbits, producers can easily predict weight of rabbit breeds from any given value of the seven body measurements. Simple tape/meter rule can be used to take the measurement of the rabbits. Substituting of the values in the regression equation for 20 weeks of age reported in this work would give close value of the body weight of rabbits at this particular age. The results of this study indicate that weaner body weight of rabbits had positive and significant effect on production traits and linear body parameters. This suggested that heavy high weaner body weight would perform more creditably than those of opposite characteristics for selection and breeding/ production programmes.

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