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Estimation of Inter-relationship Between Body Weight and Morphometric Structural Measurements of Domestic Rabbits Reared under Matured Rubber Plantation

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ABSTRACT [ENGLISH/ANGLAIS]

Morphometric structural measurements of 208 domestic rabbits (New Zealand x Chinchilla crossbred) reared under matured rubber plantation in terms of body length (BDL), head to pubic bone length (HPL), heart girth (HG), leg length (LL), thigh length (THL), shoulder width (SW) and tail length (TAL) were taken with the respective body live weights (BLW) and correlated with one another. The body measurements were also evaluated as predictor of body weight. All the parameters studied or measured were strongly and positively correlated with one another and highly significant ($p < 0.01$). The Pearson's correlation coefficient (r) ranged from 0.51 between SW and TAL to r = 0.93 between LL and HPL. The regression equations of body measurements with BLW were highly significant ($p < 0.01$) and positive with higher coefficients of determination (61.1 – 84.8%). The heart girth had the highest body weight prediction value (84.8%) closely followed by HPL (81.4%) and BDL (74.8%). The regression of BLW on seven body measurements of rabbits was highly significant ($p < 0.01$) and showed a better prediction (R^2 = 95.2 %) than with each of the body measurements alone. The body live weight of rabbit could be predicted in fields and markets from morphometric measurements taken with tape rule to maximize their profit through proper pricing.

Keywords: Body measurement, prediction equation, proper pricing, tape rule

RÉSUMÉ [FRANÇAIS/FRENCH]

Morphométriques des mesures structurelles de 208 lapins domestiques (Nouvelle-Zélande x Chinchilla croisés) élevés dans des plantations de caoutchouc mûri en termes de longueur du corps (BDL), la tête à longueur de l'os pubien (HPL), le périmètre thoracique (HG), la longueur des jambes (LL), de la cuisse longueur longueur (THL), la largeur des épaules (SO) et de la queue (TAL) ont été prises avec le poids corporel respectifs en direct (OFAG) et en corrélation avec l'autre. Les mensurations ont également été évalués comme prédicteur du poids du corps. Tous les paramètres étudiés ou mesurés étaient fortement et positivement corrélée avec l'autre et hautement significative (p <0,01). Le coefficient de corrélation de Pearson (r) variait de 0,51 entre les SW et TAL à r = 0,93 entre LL et HPL. Les équations de régression de mensurations avec BLW étaient hautement significatives (p <0,01) et positive avec des coefficients plus élevés de la détermination (de 61,1 à 84,8%). Le tour de poitrine avait la plus grande valeur de prédiction de poids corporel (84,8%) suivie de près par HPL (81,4%) et la BDL (74,8%). La régression de BLW sur sept mensurations de lapins était hautement significative (p <0,01) et a montré une meilleure prédiction (R2 = 95,2%) qu'avec chacune des mesures du corps seulement. Le poids vif de lapin peut être prédite dans les champs et les marchés à partir de mesures morphométriques prises avec la règle de bande afin de maximiser leur profit grâce à la tarification adéquate.

Mots-clés: La mesure du corps, équation de prédiction, tarification adéquate, une règle de bande

INTRODUCTION

Rabbits (*Oryctolagus cuniculus*) are good sources of meat that is tasty, of good quality and similar to chicken meat with few or no religious taboo against its consumption. They grow rapidly because they are efficient at converting feed and forages or vegetative matter into meat besides their high productivity or fecundity. Rabbits can be grown in hutches under mature rubber plantation where they can be well shaded to add value to outputs from rubber trees, provide table meat for the farmer and his family and serve as a source of extra cash for maintaining the plantation.

Body live weight is of utmost importance in determining the growth rate of an animal and its price during sales period in farms and markets. Farmers and prospective buyers often use eye judgment which may not be that accurate during marketing as the weighing scale is not that always available. Therefore the use of ruler or tape rule for simple morphometric structural or body measurements with relevant prediction equation will be a useful tool in determining body weights under emergencies and market conditions.

Given that the majority of genes influencing the configuration of an animal are of common action and not local, the formation of one part is found narrowly correlated with the formation of the other [1]. External body measurements of animals have been extensively used to characterize and evaluate breeds of animals [2,3], assess the skeletal parts to investigate possible correlate of carcass composition. It has also been used to predict body live weights in poultry [4,5], goats [6], sheep [7] and cattle [8].

This study therefore aimed at estimating the inter-relationship that exist between body weight and morphometric structural measurements of domestic rabbits reared under matured rubber plantation in order to make pricing and marketing of rabbits easier on farms and markets.

MATERIALS AND METHODS
Location and Management
Body live weights (BLW) and linear body measurements of 208 New Zealand - Chinchilla crossbred rabbits at different stages of growth reared under matured rubber plantation at the Rabbitary unit of Rubber Research Institute of Nigeria, Iyanomo, Benin City, Nigeria were taken. Body weights were measured using weighing scale while the body linear or morphometric structural measurements were taken in centimeter using a flexible tape rule. The animals were housed individually in each of the 6 cells within the rabbits' hutch. Feed and water were offered *ad libitum*. Rabbit mash containing 40% maize, 15% groundnut cake, 21.4% palm kernel cake, 2% bone meal, 2% limestone, 18% rice bran, 0.3% salt, 0.4% lysine, 0.4% methionine and 0.5% vitamins and minerals was offered in the morning while *Pueraria pubscens* forage was offered in the afternoon. Normal and standard management practices were observed.

Data Collection
Morphometric traits or body measurements taken were from 136 bucks and 72 does of different ages and it include the Body Length measurements-BDL (the distance or length between the anterior part of the shoulder to the junction between the hip and the tail); head to pubic bone length-HPL (the distance from the head to the posterior extremity or distal end of the pin or pubic bone); Leg length-LL (taken from the ball and socket joint of the pelvic girdle to the shank and the toe of the hind leg); Thigh Length-THL (from the thigh to the knee hinge joint); Shoulder Width-SW (width of shoulders); and the Tail Length (TAL).

Statistical Analyses
All data obtained were subjected to descriptive statistics, Pearson correlation and regression analysis using using SAS [9]. Prediction equation for BLW was generated from each of the linear measurements and their respective Coefficient of determination (R^2) was used to indicate and compare the efficiency or accuracy of prediction. The regression model used was:

$Y = a + bX$ for single variable and

$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + \ldots$ for multiple variables.

Where Y = dependent variable or BLW; a = intercept; b = regression coefficient of parameters determined and the X's are the independent variables or body linear measurements

RESULTS AND DISCUSSION
The descriptive statistics of body live weight and linear body measurement of rabbits reared under matured rubber tree is as shown in Table 1. The mean body live weight-BLW (kg), BDL (cm), HPL (cm), LL (cm), THL (cm), TAL (cm), HG(cm), and SW (cm) of the rabbits were 1.89, 30.4, 39.5, 18.8, 10.4, 8.00, 25.8 and 8.98 respectively. The BDL, HPL and HG had higher deviation of 5.67, 7.08 and 4.07 respectively while the least deviation was obtained for the TAL (1.66).

The Pearson's correlation coefficients among body weights and linear measurements are presented in Table 2. All the parameters studied or measured were strongly and positively correlated with one another and highly significant ($p < 0.01$) which is an indication that morphometric structural or body linear measurements could be used to predict BLW and any other traits or measurements reported with reasonable accuracy. The correlation coefficient (r) ranged from 0.51 between SW and TAL and 0.57 between TAL and THL (which were the least correlated) to r = 0.92 between HG and BLW and r = 0.93 obtained as correlation coefficient between HPL and BDL and also between HPL and LL.

Table 1: This table shows descriptive Statistics of body weight and body measurements of rabbits reared under mature Rubber trees.

Body Parameters	N	Mean	Standard Deviation	SEM
Body Live Weight (BLW)	208	1.89	0.54	0.07
Body Lt.(BDL)	208	30.4	5.67	0.79
Head to pubic bone Length (HPL)	208	39.5	7.08	0.98
Leg Length (LL)	208	18.8	3.64	0.51
Thigh Length (THL)	208	10.4	1.84	0.26
Tail Length (TAL)	208	8.00	1.66	0.23
Heart Girth (HG)	208	25.8	4.07	0.57
Shoulder width (SW)	208	8.98	1.94	0.27

Higher correlation (r = 0.92) obtained between HG and BLW is in concordance with the earlier reports of Yakubu *et al* [10] and Tiamiyu et al [11]. Akanno and Ibe [12] and Chineke [13] also observed strong and positive correlation coefficients between body weights and linear body measurements.

Table 2: This table shows Pearson's Correlation coefficients among body weights and linear measurements.

Body Parameters	BLW	BDL	HPL	LL	THL	TAL	HG
BDL.	0.87						
HPL	0.90	0.93					
LL	0.82	0.87	0.93				
THL	0.74	0.70	0.75	0.84			
TAL	0.71	0.67	0.66	0.64	0.57		
HG	0.92	0.77	0.82	0.79	0.82	0.70	
SW	0.78	0.73	0.76	0.74	0.71	0.51	0.66

Table 3: This table shows linear relationships between body measurements and body weights of rabbits reared under matured rubber plantations.

BLM (cm)	Regression equation	R^2 (%)	SEM	Significance level
BDL	BLW(kg) = - 0.609 + 0.0821BDL	74.8	0.01	0.0001**
Head to Pubic bone Length (HPL)	BLW(kg)= - 0.824 + 0.0686HPL	81.4	0.01	0.0001**
Thigh Length(THL)	BLW = - 0.374 + 0.218THL	55.6	0.02	0.0001**
Heart Girth(HG)	BLW = - 1.25 + 0.122HG	84.8	0.01	0.0001**
Shoulder width(SW)	BLW = - 0.064 + 0.217SW	61.1	0.02	0.0001**
Leg Length(LL)	BLW = - 0.401 + 0.121 LL	67.5	0.01	0.0001**

*** = p < 0.01 (1%)*

The linear relationship between body measurements and body live weights of rabbits reared under mature rubber plantation is as shown in Table 3. The regression equations of body measurements with BLW were highly significant (*p < 0.01*) and positive. The coefficients of determination were also positive and higher as the value (R^2) ranged from 61.1% for SW to 84.8% for HG. The more highly correlated traits with BLW were the HG (R^2 = 84.8 %), HPL (R^2 = 81.8%) and the BDL (R^2 = 74.8 %) whose degree of predictability was also greater or higher.

The observation is in accordance with the reports of Yakubu et al [10] and other reports on other animals like goats, sheep, chicken, cattle etc. [5,6,7,8,14].

The regression of BLW on seven body measurements or dimensions (BDL, HPL, LL, THL, TAL, HG and SW) of rabbits showed a better prediction than with each of the body measurements alone by being highly significant (*p < 0.01*) with higher coefficient of determination (R^2 = 95.2 %). The prediction equation is shown below:

BLW = - 1.38 + 0.0103BDL + 0.0315HPL - 0.0302 LL - 0.0471THL + 0.0098TAL + 0.0826 HG + 0.0626SW.

By using the regression or prediction equations so generated from this study based on their strong relationships or correlations, coefficient of determination and their highly significant values with BLW, the BLW of rabbits can be predicted by merely using tape rule to measure the linear body parameters in rural communities or markets where sensitive weighing scales are not readily available [15]. Knowing the actual or relative weights of rabbits in markets will enable proper pricing and will help to maximize profit.

CONCLUSION

There are positive, strong and significant relationships between body live weight and morphometric structural measurements of rabbits reared under matured rubber plantation.

The regression or prediction equations generated from body measurements are positive and strong and can be accurately employed to predict the relative body weight of rabbits in fields and markets with the use of tape rule.

REFERENCES

[1]   Lener LM, Donald HP. Modern development in animal breeding. Academic Press, London. 1996,p. 295.

[2]   Salako AE, Ngere LO. Application of multifactorial discriminant analysis in the morphometric structural differentiation iof West African Dwarf (WAD) and Yankasa Sheep in south west Nigeria. Nigerian Journal for Animal Production 2002;29(2): 163–7.

[3]   Fahmy MH, Salah E, Galal E. A study of weights and body dimensions of lambs and the prediction of weights using some linear dimensions. Tropical Agriculture 1968;45:33–8.

[4]   Semakula J, Lusembo P, Kugonza DR, Mutetikka D, Ssennyonjo J, Mwesigwa M. Estimation of live body weight using zoometrical measurements for improved marketing of indigenous chicken in the Lake Victoria basin of Uganda Livestock Research for Rural Development 2011;23(8):170.

[5]   Gueye EF, Ndiaye A, Branckaert RDS. Prediction of mature body weight on the basis of body measurement in mature indigenous chickens in Senegal. Livestock Research for Rural Development, 1998;10(3) Available from: http://www.cipav.org.co/lrrd/html.

[6]   Ozoje MO, Herbert U. Linear measurements in West African Dwarf (WAD) and WAD x Red Sokoto goats. Nigerian Journal of Animal Production 1997;24(1):13–9.

[7]   Yakubu A, Abdullah AR, Ari MM, Ogah DM. Studies on live weight and linear body measurements of West African dwarf sheep in north central Nigeria. Production Agric. And Technology (PAT) 2005;1:137–145.

[8]   Orheruata AM, Olutogun O. Pre-weaning phenotypic relationships between some N'dama cattle linear measurements in the tropics. Nigerian Journal of Animal Production 1994;22:76–82.

[9]   SAS. Statistical Analysis Systems. Institutions Users Guide,version 9.2 SAS Institute inc., Cary, NC 275513.UK.2009.

[10] Yakubu A, Salako AE, Ogah DM, Barde RE, Oyefeso S. Estimation of body weight from linear body measurements in domestic rabbit (Oryctolagus cuniculus). In: Proceedings of the 38th Annual Conference of the Agricultural Society of Nigeria(ASN) 2005b;p.548-51.

[11] Tiamiyu AK, Raji AM, Babatunde BB, Hamzat RA. Interrelationships among the body measurements in medium breed rabbits. In: Proceedings of 25th Annual Conference of Nigeria Society for Animal Production (NSAP), 19 – 23 March, 2000. Umudike. 2000; p.252–3.

[12] Akanno EC, Ibe SN. Prediction of body weight of the domestic rabbit at different stages of growth using linear body measurements. Nigerian Journal of Animal Production 2006;33:3–8.

[13] Chineke CA. Characterization of physical body traits of domestic rabbit in humid tropics. In: Proceedings of 25th Annual Conference of Nigeria Society for Animal Production (NSAP), 19 – 23 March, 2000. Umudike.2000;p.237–9.

[14] Bhat PW, Bhat PP, Gerg RC. Note on predicting pre-weaning weight using linear body measurement in sheep. Indian Journal of Animal Science 1980;50:657–9.

[15] Nesamvuni AE, Malaudzi J, Ramanyimi ND, Taylor GJ. Estimation of body weight in Ngunni-type cattle under communal conditions.South African Journal of Animal Science 2000;30(Supplement 1) Available from: http://www.sasas.co.za/sajas.html

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CONFLICT OF INTEREST

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