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Original article

Comparative prediction analysis of body weight from biometric traits in F1 New Zealand white purebred and its California cross bred rabbits

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ABSTRACT

One hundred and forty four (144) F1 New Zealand White purebred and New Zealand White x California crossbred rabbits at eight weeks old were used to estimate bodyweight from body measurements using regression analyses. Ten biometric measurements were made on each individual animal. New Zealand White x California crossbred were superior (P<0.05) to the New Zealand White purebred for bodyweight but biometric measurements were not statistically significant (P>0.05) between the two breed types. Phenotypic correlations were found to be positive and significance (P<0.01) for both genotypes. The regression analysis was more sensitive in New Zealand White x California crossbred (R2=0.85-0.91) compared to New Zealand White purebred (R2=0.84-0.89). In conclusion, body weight could be predicted from biometric measurements for both genotypes accurately using tape measures.

1. Introduction

Biometric measurements are used indirectly for on the spot assessment of body weight in animals in settings where measuring scales are absent. Estimating the body weight using body measurements is practical, faster, easier, and cheaper in the rural areas where the resources are insufficient for the breeder (Nsoso et al., 2003). Several charts that show the estimated weights according to the body measurements are established in the countries where animal industry is developed. The use of measuring scale can be problematic for farmers due to lack of technical skills required in its operation and the ability to immobilize the animals during measurement. Therefore, the conditions for accurate weighing and measurement are seldom met in the field. The use of accurate knowledge of anatomy in monitoring weight is more flexible and easy-to-attain for most of the farmers. For these reasons, this paper deals with estimation of body weight from body measurements using simple statistical procedures.

2. Materials and methods

2.1. Study location and experimental animals

The experiment made use of 144 F1 eight weeks old rabbits which consisted of 74 New Zealand White purebred and 70 New Zealand White x California crossbred in rabbit unit of National Animal Production Research Institute (NAPRI), Shika. The animals were intensively managed under air conditioned building to minimise heat stress. They were fed a pelletized diet in the mornings and green grasses such as guinea grass (Panicum maximum) were given in the evenings.

2.2. Body parts measured

Body weight was taken by digital weighing scale (Mettler Toledo, Top Pan Sensitive Balance, J. Liang Int. Ltd. U.K.). The measurements were taken while the animals were held in a standing position. Ten (10) biometric traits were determined using a tape measure on each animal. The anatomical reference points were in accordance with standard zoometrical procedures (Gueye et al., 1998; Teguia et al., 2008). The body components measured were: Body length (BL): diagonal distance from the points of shoulder to points of hip or first thoracic vertebrae to base of tail or to hip bone. This is also described as the distance between the most cranial palpable spinosus process of the thoracic vertebrae and either sciatic tubers or distance between the tops of the pelvic bone; Ear length (EL): measured from the ear base to the zygomatic arch of the ear; Tail length (TL): measured from the base of the tail to the tip (Coccygeal vertebrae); Heart girth (HG): This refers to the body circumference and was measured just behind the fore-legs; Head to shoulder (HS): Is the distance from nose to the point of the shoulder; Shoulder to tail-drop (STT): This is the distance from the point of the shoulder to the pin bone (otherwise called Coccygeal vertebrae); Height at withers: This was taken using a graduated measuring stick; Thigh circumference: This refers to the circumference of the thigh; Length of front and back leg (LFL and LBL): This is the length of front and back legs. All biometric traits were measured in centimetre.

3. Statistical analysis

All data obtained were subjected to general linear model procedures to estimate for variation in breed types. Proc corr and Proc reg procedures of SAS [9.2] were used for the prediction analysis. Coefficient of determination (R2) was used as a baseline for determining the accuracy of prediction model.

3.1. Experimental model

Yijk = μ + B1 + eijk
Yijk = Observation on Kth litter from in ith breed
μ = Overall population mean
B1 = effect of ith breed types (i= NZW purebred and NZW XCAL crossbred rabbits)
eijk = random error

3.1.1 Regression model

Y = a+bX for single variable and
Y = a+b1X1+b2X2+ b3X3+ b4X4+ b5X5+ b6X6+ b7X7+ b8X8+ b9X9+ b10X10 (Multiple variables).

Where Y=dependent variable; a= intercept; b=regression coefficient and the X'S are the independent variables or body measurements. The type of procedure used was a stepwise regression where variables that are natural redundant were deleted from the model.

4. Results

Least Square Means (± S.E) of body weight and biometric traits are presented in Table 1. Average body weight differs significantly ($P < 0.05$) by breed type. Body measurements was not significantly ($P > 0.05$) affected by breed type. NZW Purebred rabbits however had higher values in traits such as EL, NTS, STT, BL, BW, TC and TL compared to NZWXCAL crossbred rabbits. Crossbred NZWXCAL rabbits showed higher values in traits such as HW, LFL, LBL and HG compared to the purebred NZW rabbits.

Table 2 shows the correlation between body weight and biometric traits. Phenotypic correlations between bodyweight and biometric traits were highly associated and positive for Hyla purebred and crossbred rabbits. The highest correlation was recorded between STT – BW (r = 0.96) while the lowest correlation was observed between LFL – BW (r = 0.60) in purebred rabbits. In the crossbred, the highest correlation was obtained between STT – BW (r = 0.94) while the lowest correlation was recorded between LFL – BW (r = 0.62).

The Stepwise regression of bodyweight predicted from body measurements in NZW purebred and NZWXCAL crossbred rabbits are shown in Table 3. The coefficient of determination (R2) was higher in the NZWXCAL crossbred (0.84-0.89) compared to NZW purebred (0.85-0.91) rabbits. Combined traits showed higher regression estimates for both genotypes compared to when a single trait was used as a sole predictor.

Table 1
Least squares means ± SEM of body weight and biometric traits.

Least Squares Means ±SEM of Body weight and Biometric traits		
Traits	**NZW Purebred**	**NZWXCAL Crossbred**
BW	1290.72±14.22[b]	1300.52±22.21[a]
EL	10.09±0.06	10.07±0.09
NTS	10.99±0.08	10.81±0.11
STT	27.83±0.17	27.71±0.27
BL	25.36±0.18	25.31±0.28
TC	7.47±0.06	7.47±0.10
HW	8.96±0.06	8.99±0.09
LFL	11.63±0.10	11.83±0.16
LBL	17.69±0.20	17.84±0.31
HG	23.69±0.18	23.98± 0.28
TL	7.11±0.06	7.10±0.09

[abc]Means within the same column having the same superscript are not significantly(P>0.05) different
SE- Standard Error. EL – ear length, NTS- Nose to shoulder, STT-Shoulder to tail drop, BL- Body length, TC-Thigh circumference, HW- Height at wither, LFL and LBL-Lenght of front and back leg, HG-Height girth and TL-Tail length. BW-Bodyweight

Table 2
Phenotypic Correlations of Body weight and Biometric traits of NZW purebred and NZWXCAL Crossbred Rabbits.

Traits	**BW**	**HW**	**BL**	**HG**	**TL**	**TC**	**LFL**	**LBL**	**STT**	**EL**	**NTS**
BW		0.80	0.90	0.86	0.77	0.74	0.62	0.69	0.91	0.84	0.87
HW	0.86		0.80	0.68	0.66	0.65	0.60	0.61	0.78	0.76	0.73
BL	0.89	0.86		0.87	0.84	0.81	0.72	0.71	0.96	0.89	0.86
HG	0.88	0.76	0.85		0.76	0.71	0.62	0.64	0.89	0.80	0.81
TL	0.79	0.76	0.85	0.82		0.79	0.69	0.74	0.85	0.87	0.78
TC	0.77	0.76	0.86	0.79	0.87		0.68	0.69	0.79	0.83	0.78
LFL	0.63	0.67	0.72	0.62	0.72	0.71		0.67	0.69	0.78	0.68
LBL	0.71	0.70	0.73	0.66	0.73	0.68	0.71		0.70	0.77	0.69
STT	0.92	0.84	0.94	0.89	0.88	0.85	0.69	0.73		0.87	0.85
EL	0.84	0.83	0.89	0.82	0.88	0.88	0.79	0.79	0.89		0.86
NTS	0.87	0.79	0.86	0.83	0.81	0.79	0.66	0.71	0.86	0.87	

BW-Body weight, EL-Ear length, HG- Heart girth, TL – Tail length, STT- Shoulder to tail drop, LFL-Length of front leg, LBL- Length of back leg, TC- Thigh circumference, BL- Body length, HW-Heigth at wither, NTS- Nose to shoulder, LBMs- Linear body measurement. Upper matrix= Hyla purebred, Lower matrix= Hyla crossbred, Significant at $P < 0.01$ for all correlation coefficients.

Table 3
Stepwise regression of bodyweight predicted from body measurements in NZW purebred and NZWXCAL crossbred rabbits.

Stepwise regression of bodyweight predicted from body measurements in NZW purebred and NZWXCAL crossbred rabbits		
NZW Purebred		
Originalbody measurements as explanatory variables		
STT	BW=-789.63+63.32STT	0.84
STT and NTS	BW=-1086.24+44.56STT+74.48NTS	0.86
STT, NTS and HW	BW=-1086.79+37.37STT+63.71NTS+35.59HW	0.88
STT, NTS, HW and HG	BW=1186.43+27.04STT+55.14NTS+38.00HW+19.41HG	0.88
STT, NTS, HW, HG and LFL	BW=-1122.81+29.50STT+93.16NTS+40.06HW+18.97HG-19.63LFL	0.89
NZWXCAL Crossbred		
Originalbody measurements as explanatory variables		
STT	BW=-887.75+67.21STT	0.85
STT and NTS	BW=-1177.49+48.36STT+74.48NTS	0.86
STT, NTS and HW	BW=-1172.04+38.57STT+59.10NTS+48.36HW	0.88
STT, NTS, HW and TL	BW=-1231.29+48.84STT+68.25NTS+49.91HW+47.77TL	0.90
STT, NTS, HW, TL and HG	BW=-1333.49+37.96STT+53.82NTS+51.75HW+52.16TL+24.05HG	0.91
STT, NTS, HW, HG and LFL	BW=-1300.26+39.40STT+57.22NTS+54.14HW+38.67TL+24.87HG-32.77TC	0.91

BW-Body weight, HG- Heart girth, TL – Tail length, STT- Shoulder to tail drop, LBL- Length of back leg, BL- Body length, HW- Heigth at wither, NTS- Nose to shoulder.

130 samples were taken in 65 water tanks in all villages trevës Dragash. In each tank was taken from two water samples, one for microbiological analysis and the other for physicochemical analysis (Table 1):

Table 1
Microbiological analysis and the other for physicochemical analysis.

Nr.	Area	Physicochemic samples		Microbiology samples		Total samples	%
		N	%	N	%		
1	Opoja	30	23.07	30	23.07	60	46.15
2	Brezne	6	4.61	6	4.61	12	9.23
3	Dragash	11	8.46	11	8.46	22	16.92
4	Brod	4	3.08	4	3.08	8	6.15
5	Restelica	14	10.78	14	10.78	28	21.55
Total		65	50.00	65	50.00	130	100.00

5. Discussion

Higher values obtained for NZWxCAL crossbred rabbits for some biometric traits (bodyweight, height at wither, height girth, length of front and back leg) compared to NZW purebred rabbits have been reported by several authors (Yakubu and ayoade, 2009; Hristakieva et al. 2006) in the literature. This could be due to heterotic effects or crossbred advantage which was not estimated in this study. Non significant of breed types contrast with some reports in the literature (Kabir, 2010; Zalla et al., 2007). Phenotypic correlation between bodyweight and biometric traits were highly associated and positive for Hyla purebred rabbits with a range of 0.62 - 0.91 and crossbred Hyla rabbits with a range of 0.63 – 0.94. The present estimates were comparable with the range of values recorded for rabbits in earlier research (Yakubu and ayoade, 2009). The positive correlations between BW and biometric traits obtained in the present study indicate that an increase in any one body measurement would result in a corresponding increase in the body weight. The strong relationship existing between BW and body measurements suggests that either or a combination of these biometric traits could be used to estimate body weight in rabbits fairly well at instances where measuring scales are not available. The association may also be useful as selection criterion since positive correlations of traits suggest that the traits may be under the same genetic influences. Having established this fact, what is now required is a calibrated table which will indicate the various linear measurements and body weights they represent. When this is done, the rural farmers will overcome their present difficulties of knowing the weights of rabbits they are rearing or they want to sale in a situation where measuring scales are not available. The range of values reported in this study for both studies were higher than the values obtained by several authors (Kolawole et al., 2012; Yakubu and ayoade, 2009; Hamouda et al., 1990) in tropical countries.

6. Conclusion

According to the results of this study, it could be concluded that body weight could be estimated from body measurements using a simple prediction techniques.

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