PREDICTION OF BODY WEIGHT THROUGH BODY MEASUREMENTS IN BEETAL GOATS

M. Iqbal, K. Javed and N. Ahmad

Department of Livestock Production, University of Veterinary and Animal Sciences, Lahore, Pakistan
Corresponding Author**:** Prof. Dr. Khalid Javed, Email: khalidjaved@uvas.edu.pk

ABSTRACT: The present study was carried out at Small Ruminants Training and Research Centre, University of Veterinary & Animal Sciences (UVAS) Ravi campus, Lahore Pakistan. The goats (n = 230) falling in age group 13-18 months were included in the resent investigation. Live weight (LW) and other body characteristics recorded were body length (BL), height at withers (HW), chest girth (CG), rump (RP), and forehead (FH) were (inches) 27.16±3.94 (Kg), 27.00±1.35, 28.34±1.32, 27.00±1.41, 5.28±1.48 and 3.18±1.26, respectively. Significant and positive correlation coefficients between live weight and other body characteristics: body length, height at withers, heart girth, rump and forehead (0.805, 0.766, 0.767, 0.088 and 0.229, respectively) were observed. All measurements for different body characteristics were included in model. Stepwise elimination procedure was adopted to eliminate unfit body measurements (rump and forehead) in the model. Body length, withers height and heart girth were found to be best fit accounting for 70 % of the live body weight in females Beetal goats. The coefficient of determination (R^2) for body length (64.8 %) was higher than other body measurements in single trait evaluation indicating it as the best trait for the predication of live weight. The most appropriate combination of body characteristics (R^2 = 69.1 %) was observed between height at withers and heart girth for predication of live body weight estimation, where as rump and forehead were the poor estimators of body weight with coefficient of variation (R^2) as 25.93% and 16.64%, respectively.

Key words: Beetal goat, prediction, morphometric measurements, coefficient of determination

INTRODUCTION

In Pakistan twenty four recognized breeds of goats are found, in which four are in Punjab province, namely Beetal, Nachi, Teddi and Dera Din Pannah. Beetal is the goat of central Punjab which is mainly kept for milk and meat production and it is also called as poor man's cow which fulfills the requirements of milk for a family, the male is mainly kept for meat purposes specially for Eid-ul-duha whereas Teddy is considered to be more prolific and fast growing breed of goat (Kuthu *et al*., 2013)

The body conformations and their measurements are valuable for estimation and judging the meat quality parameters and also useful for the development of selection procedures for the improvement of different livestock species (Islam *et al*., 1991). The knowledge regarding the live weight of a goat or sheep is important for many reasons (development of selection strategies, feeding management, health care and consumer's choice for slaughtering. Such type of basic knowledge is not available to small scale poor goat keepers where weighing scales are not usually available. It is common for the farmers to rely on non realistic estimates of their animals. This leads to inappropriate breeding schemes and feeding strategies. The regression of body weight on different body measurements easily measureable, is usually a method of choice for prediction of body weight. Different body measurements have been used to estimate body weight for Indian goats (Ulaganathan *et al*., 1992 Singh and Mishra, 2004), Sahel goats of Nigeria (Mohammad and Amin, 1996; Slippers *et al* 2000), West Africal Dwarf goats (Mayaka *et al*., 1995). On Pakistani goat breeds is not available. There is a need to develop a model for estimating body weight through physical measurements in Beetal goats. Different models have been suggested by Enevoldsen and Kristensen (1997) which needs to be evaluated to predict body weight in diverse environmental conditions and different breeds.

It was therefore designed the present investigation to make best prediction of live body weight of Beetal goat under the environmental condition of Punjab.

MATERIALS AND METHODS

The current study was carried out Research Farm for small ruminants which was established during the year 2007 at University of Veterinary & Animal Sciences (UVAS) Ravi campus, Pattoki. A flock of 400

Beetal goats (all age groups) is being reared under semi intensive system i.e. grazing and stall feeding. All the animals were tagged with permanent ear tag number, to each and every individual animal of the farm. The body measurements were recorded for height at withers, forehead, rump, body length and heart girth after Sasimowski (1987).

All individual animals (age 13-18 months) were weighed for actual body weight. Height at withers was measured from the highest point over the scapulae vertical to the ground. Heart girth was obtained from the smallest circumferences just behind the foreleg. Body length was recorded from the point of shoulder to pin bone. The age was determined using the dentition method as described by Devendra and Mcleroy (1982) or from the farm records.

All the data collected were analyzed statistically through SPSS computer software version 10.0 (SPSS, 1999) for regression (linear and non linear). Stepwise multiple regression analysis was performed to elaborate regression equations for prediction of live weight of Beetal goats. Accuracy of prediction equation for morphometery was estimated through the coefficients of multiple determinations (R^2); linear relationship between live weight and other five body measurements using Pearson correlation coefficients (r_p) was also calculated. Best-fitted regression equation was developed to estimate live weight through different morphometric measurements.

RESULTS AND DISCUSSION

The overall means along with standard deviation (means ±S.D) for live weight (kg), body length (inch), height at withers (inch), heart girth (inch), rump (inch) and forehead (inch) in Beetal goats (age group 13-18 months) are presented in Table 1. The relationships between live weight and other measurements, analysis is variance and regression analysis are presented in tables 2 and 3. The overall means± S.D for body weight (kg), body length (inch), height at withers, heart girth, rump and forehead were 27.16±3.94 (kg), 27.00±1.35 (inch), 28.34±1.32 (inch), 27.00±1.41 (inch), 5.28±1.48 (inch) and 3.18±1.26 (inch), respectively.

The findings of the present study are in partially agreement with those of Moaeen-ud-Din *et al.* (2006) who reported 64.97 (cm) body length, 70.23 (cm) height at withers and 61.29 (cm) hearth girth, in Crossbred goats. Whereas Hamayun *et al*. (2006) reported mean body length, 60.14 (cm); withers height 63.14 (cm) and heart girth 61.29 (cm) in Beetal goats, which are not in agreement with the findings of the present study. Shettar and Rudresh (2003) reported mean body weight (31.33±0.20 kg) in Bidri goats which is higher than that of present study. The observations of the current investigation are somewhat different from those of Hamayun *et al.* (2006) who reported low mean body weight (21.0±3.47 kg) in Beetal female goats of same age group (13-18 months). The difference in the mean body weight of same breed may be due to size of the group and variation within group, as they selected only 7 Beetal goats for their experiment. The variation in various body measurements in different reports may be due to difference in breeds, environment, size of data set and other managemental practices

Table 1: Means ± S.D of live body weight and other body measurements in Beetal female goats

Body weight observation	No. of observation.	Mean± S.D
Weight (kg)	230	27.16±3.94
Length (inch)	230	27.00±1.35
Height at wither (inch)	230	28.34±1.32
Heart girth (inch)	230	27.00±1.41
Rump (inch)	230	5.28±1.48
Forehead (inch)	230	3.18±1.26

Correlation coefficients between live weight and other body measurements: The correlation coefficients between body weight and other body measurements; body length, height at wither, heart girth, rump and forehead were 0.805, 0.766, 0.767, 0.088 and 0.229, respectively. Positive and significant correlation coefficients between body weight and body measurements were observed. The correlation coefficients between body weight and other body measurements; body length, height at withers, heart girth, rump and forehead were 0.805, 0.766, 0.767, 0.088 and 0.229 respectively. There was a significant and high correlation between body weight and body length, indicating that these two traits tends to move together and measurements of one may be used to estimate the other. Our results are in agreement with the work of Fasae *et al.* (2005) and Afolayan *et al.* (2006) in Yankasa sheep; Bassano *et al.* (2003) Alpine Ibex; Sowande and Sobola (2007) in West African dwarf sheep and Younas *et al.* (2013 in Hissaldale sheep. Salako (2006) reported positive and significant correlation among body dimension, in Uda Sheep which support the findings of the present investigation.

Regression analysis

Multiple Linear Regression Model and body weight estimation using stepwise multiple regression analysis for female Beetal goats: The multiple linear equations for estimating live body weight from body measurements of Beetal goat are presented in Table 4. All five body measurements (body length, withers height, heart girth, rump and forehead) were included

in model and through stepwise elimination procedure, two of the body measurements (rump and forehead) were found to be unfit in the model. The three body measurements (body length, withers height and heart girth) were best fitted accounting for round about above 60% of the live body weight in females Beetal goats.

Table 2: Regression analysis for body length, height at withers, heart girth, rump and forehead

Source of Variation	Degree of freedom	Sum of Squares	Mean squares	F-Ratio	P-value
Regression	5	2495.852	499.170	103.913	0.001
Residual	224	1076.035	4.804		
Total	229	3571.887			

Table 3: Body weight estimation in Beetal goats by means of stepwise multiple regression analysis

Prediction Equations	β_0	β_1	β_2	β_3	β_4	β_5	R^2
$Y_i = \beta_0 + \beta_1 x_1$	-34.60	2.36	-	-	-	-	64.8%
$Y_i = \beta_0 + \beta_2 x_2$	-36.83	-	2.24	-	-	-	58.6%
$Y_i = \beta_0 + \beta_3 x_3$	-30.31	-	-	2.12	-	-	58.8%
$Y_i = \beta_0 + \beta_4 x_4$	25.93	-	-	-	0.23	-	25.93%
$Y_i = \beta_0 + \beta_5 x_5$	16.64	-	-	-		3.30	16.64%
$Y_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2$	-42.3	1.54	1.00	-	-	-	69.1%
$Y_i = \beta_0 + \beta_1 x_1 + \beta_3 x_3$	-36.0	1.72	-	0.62	-	-	65.8%
$Y_i = \beta_0 + \beta_2 x_2 + \beta_3 x_3$	-42.5	-	1.30	1.22	-	-	67.73%
$Y_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3$	-43.0	1.10	0.96	0.51	-	-	69.7%
$Y_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5$	-42.78	1.04	0.95	0.60	-0.11	-0.17	69.9%

Y_i = Body weight in kg, β_0 = intercept of the best fit straight line,
x_1 = body length, x_2= Height at wither, x_3 = Heart girth, x_4 = Rump and x_5 = Forehead in inches.
$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ = Partial regression co-efficient of body weight on body length, height at wither, heart girth, rump and forehead respectively. R^2 = coefficients of determination.

The coefficient of determination (R^2) for body length (64.8%0 was higher than other body measurements in single trait evaluation. The height at withers and heart girth (58.6 and 58.8 %) were next to body length. The coefficient of determination (R^2) was higher for height at withers and heart girth as compared to other body measurements, whereas rump and forehead were the poor estimators of body weight with coefficient of variation (R^2) as 25.93% and 16.64%, respectively.

Various multiple linear regressions were analyzed to predict the best fitted regression equation for Beetal goat for estimating body weight at 13-18 months of age. Multiple regression with body length, height at withers and heart girth followed by body length + withers height, body length + heart girth and height at withers + heart girth to find out the best fitted regression line for Beetal goat are presented in Table 4.

The best fitted regression found for adult goats (13-18 months of age) was body length and height at withers on body weight.

$Y_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2$

Weight = -42.3+ 1.54 (body length) +1.00 (height at withers) (Table 3)

More variation in live weight is described as the higher coefficient of determination (R^2) for different body measurements. The body weight with multiple regressions was estimated with the combination of body length and height at withers, while weight can be more accurately estimated through the single body measurement with body length. In this age group the height at wither and heart girth and the body length were proved to be causing much variation in live weight of female goats. These results are very close to Mukkerjee *et al.* (1981) who reported that body weight can be best estimated with the combination of body length and height at withers. The findings of the present study contradict with the findings of Prasad *et al.* (1981) who reported a non significant regression on body length and height at withers. However live body weight estimation in Beetal females goats above one year can be best estimated with the combination of three body measurements, body length, height at withers and heart girth.

The financial contribution to livestock production enterprises depends upon the accuracy of measuring body functions. The relationship between body characteristics and animal measurements determined by both buyer and the producer are essential for optimum production and value based trading systems and also for efficient feeding/ breeding operations. The ability to determine this relationship invariably provides more options to farmers for maximum returns in all production systems in general and especially in the developing countries.

REFERENCES

Afolayan, R. A., I. A. Adeyinka and C. A. M. Lakpini The estimation of live weight from body measurements in Yankasa sheep.National Animal Production Research Institute, Ahmadu Bello University, Shika-Zaria, Nigeria**.** Czech. J. Anim. Sci. 51(8): 343-348 (2006). **.**

Bassano, B., D. Bergero and A. Peracino. Accuracy of body weight prediction in Alpine ibex (Capra ibex, L. 1758) using morphometry. J. Anim. Physiol. Anim. Nutr (Berl).87(3-4):79-85 (2003)..

Davendra, C. and G. B. Mcleroy. Goat and sheep production in the tropics. J. Anim. Sci. 63:20-21(1982).

Enevoldsen, C. and T. Kristensen. Estimation of body weight from body size measurements and body condition scores in dairy cows. J. Dairy Sci. 80:1988-1995 (1997).

Fasae, O.A.1., A.C. Chineke, and J. A. Alokan. Relationship between some physical parameters of grazing yankasa ewes in the humid zone of Nigeria. Arch. Zootec. 54: 639-642(2005).

Hamayun, K., F. Muhammad., R. Ahmad, G. Nawaz, Rahimullah and M. Zubair. Relationship of body weight with linear body measurements in goats. J. Agri and Biological Sci. 1 (3):51-54 (2006).

Islam M. R., M .Saadullah, A. R. Howlider and M. A. Huq. Estimation of live weight and dressed carcass weight from different body measurements in goats. J. Anim. Sci. 61(4): 460-461(1991).

Kuthu, Z. H., K. Javed. M. E. Babar, A. Sattar and M. Abdullah. Environmental effects on growth traits of Teddy goats. The J. Anim. Plant Sci., 23 (3): 692-698 (2013).

Mayaka, T. D., J. Tchoumboue , Y. Manjeli and A. Teguia. Estimation of live weight in West African Dwarf goats from heart girth measurement. Trop. Anim. Health and Production. 28:126-128 (1995).

Moaeen-ud-Din, M., N. Ahmad., A. Iqbal and M. Abdullah. Evaluation of different formulas for weight estimation in Beetal, Teddi and Crossbred (BeetalxTeddi) goats. The J. Anim. Plant Sci. 16(3-4):70-74 (2006).

Mukeerjee, D.K., S.K. Singh, and H.R. Mishra. Phenotypic correlation of body weight with body measurement relationship in Grey Black Bengal goats. Indian. J. Anim. Sci.51:682-694(1981).

Salako, A. E. Principal Component Factor Analysis of the Morphostructure of Immature Uda Sheep Análisis Factorial de los Principales Componentes de la Morfoestructura de Ovejas Uda Inmaduras Animal breeding and Genetics Unit, Department of Animal Science, University of Ibadan, Ibadan, Nigeria. Int. J. Morphol. 24(4):571-774 (2006).

Shettar, V. B. and B. H. Rudres. Body measurements of Bidri goats. Indian. Vet. J. 80:367-368 (2003).

Singh, P. N. and A.K. Mishra Prediction of body weight using conformation traits in Barbari goats. J. Small Ruminants 10 (2): 173 (2004).

Slippers, S. C., B. A. Letty and J. F. de villiers Prediction of the body weight of Nguni goats. South African J. Anim. Sci., 30 (1): 127-128 (2000).

Sowande O. S. and O. S. Sobola. Body measurements of west African dwarf sheep as parameters for estimation of live weight Trop. Anim. Health and Prod. Original paper Online (2007).

SPSS Statistical Package for social sciences. Procedure and facilities for release. McGraw-Hill Book Co. NY (1999).

Ulaganathan, V., K .Krishnappa, and S. Shanmugasundaram, Prediction of body weight from linear body measurements in local goats. Indian. J. Anim. Genetics and Breeding 14(2):31-32 (1992).

Younas, U., M. Abdullah, J. A. Bhatti, T. N. Pasha, N. Ahmad, M. Nasir and A. Hussain. Inter-relationship of body weight with linear body measurements in Hissardale sheep at different stages of life. The J. Anim. Plant Sci., 23 (1): 40-44 (2013).