PREDICTION OF BODY WEIGHT ON THE BASIS OF BODY MEASUREMENTS IN KARAN FRIES COWS AND MURRAH BUFFALOES*

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ABSTRACT

The relationships between body weight (BW) and body measurements such as heart girth, body length, abdominal girth, height at hook and height at withers of 199 Karan Fries (KF) cows and 268 Murrah buffaloes of NDRI herd, were investigated. The principal objective was to develop a regression equation that could be used to estimate BW. The prediction equations developed to predict the body weight from the body measurements gave an accuracy of 72.24 percent (R²) in KF cows and 66.90 per cent (R²) in Murrah buffaloes. Body measurements, mainly HG and AG were better related with BW in both the breeds, KF cows (r = 0.78 and 0.74) and Murrah buffaloes(r = 0.72 and 0.75). So, HG or AG can alone be used for prediction of body weight.

INTRODUCTION

The body weight of dairy cows is important for several management purposes including assessment of feed efficiency, the value of culled cows, and the efficiency of rearing replacement heifers. Scientific feeding of farm animals is based on their bodyweight, and hence the necessity to weigh them periodically. Periodical weighing of stock gives an idea about their condition and well being. For practical reasons, body weight is difficult to obtain regularly as weighing scales are cumbersome, expensive and difficult to transport specially in field condition. Body measurements such as Body Length (BL), Heart Girth (HG), Abdominal Girth (AG), Height at Withers (HW), Height at Hook (HH), etc. have close association with Body Weight (Desai et al., 1992; Singh et al., 1994). Body weight is a common measure of growth of all parts of the body can be estimated from these body measurements by evolving suitable regression equation (Bhalla et al., 1967; Satyanarayana and Murty, 1981). Such predicted body weight based on body measurements is having less variability because growth rate of cow is slower.

MATERIAL AND METHODS

The present study was conducted on 199 Karan Fries cows and 268 Murrah buffaloes of Cattle Yard at National Dairy Research Institute (NDRI), Karnal, ranging from 3 to 11 years of age. The herd is kept under loose housing and group management system. The fortnightly body weight of each animal was recorded early in the morning between 7.30 a.m. to 8.30 a.m. before providing the animals with any feeding stuffs or water, using electronic weighing machine with a precision of one kilogram of live body weight. The animals were measured for body measurements with a precision of one centimeter for body length (BL), heart girth (HG), abdominal girth (AG), crown rump length (CRL), height at withers (HW), height at hook (HH), distance between pins (DPN), distance between hook (DHK) and distance between pin and hook (DPH). Care was taken to avoid any type of error. The measurements were recorded, when the animal was standing evenly on her feet with her neck elevated to a position level with her back, for the maximum precision. The above body measurements were taken at the start of the experiment (January) and at fortnightly intervals till the end of the experiment (May).

The interrelationship of body weight with body measurements were studied by regression analysis (Snedecor and Cochran, 1967). Here, simple linear regression and multiple linear regression equations were used to estimate body weight from body measurements.

\[ Y = a + b_1X_1 + b_2X_2 + \ldots + b_kX_k + e_i \]

Where,
- \( Y \) = Predicted body weight (dependent variable),
- \( a \) = Intercept,
- \( b_i \) = \( i \)th regression coefficients of \( Y \) on \( X_i \),
- \( X_i \) = \( i \)th independent variable, and
- \( e \) = Random error which is normally and independently distributed with mean zero and unknown variance \([\text{NID } \sim (0, \sigma^2)]\).

Independent variables of body measurements were taken in cm.

The accuracy of the regression equations in the prediction of body weight was estimated by \( R^2 \) value (Panse and Sukhatme, 1967).

\section*{RESULTS AND DISCUSSION}

\textbf{Correlation of body measurements with body weight:} The correlations of body weight with various body measurements, viz., heart girth, abdominal girth, body length, crown-rump length, distance between pins, distance between hooks, distance between pin and hook, height at withers and height at hook were found to be significantly positive (\( P<0.01 \)) in both Karan Fries (KF) cows and Murrah buffaloes, presented in Table 1.

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|c|c|c|c|c|c|}
\hline
Particular & No. of & Body & Measurements  \\
& Observations & & & & & & & & \\
\hline
& & Heart & Abdominal & Body & Crown & Distance & Distance & Distance & Height & Height  \\
& & Girth & Girth & Length & -Rump & Between & Between & Between & at & at  \\
& & & & & Length & Pins & Hooks & Pin and Hook & Withers & Hook  \\
\hline
BW & KF 199 & 0.78** & 0.74** & 0.52** & 0.40** & 0.32** & 0.59** & 0.54** & 0.61** & 0.53** \\
& Murrah 268 & 0.72** & 0.75** & 0.52** & 0.50** & 0.43** & 0.42** & 0.50** & 0.51** & 0.35** \\
\hline
\end{tabular}
\caption{Correlation coefficients of body weight with various body measurements in KF cows and Murrah buffaloes.}
\end{table}

The significant magnitude (\( P<0.01 \)) of correlation coefficients of body weight with various body measurements indicated that increase in the various body measurements were associated with the increase in body weight of the animals.

\textbf{Prediction of body weight from body measurements:} To predict the body weight from various body measurements, simple linear and multiple linear regression equations have been tried. \( R^2 \) values have been determined for each regression equation to indicate the degree of accuracy of prediction of body weight. It was found that in KF cows using HG, AG, BL, CRL, DPN, DHK, DPH, HW and HH as independent variables could give \( R^2 \) value of 72.24 per cent in multiple linear regression equation. The prediction equation derived as follows;

\[ Y_i = (-681.87) + 2.19 \text{HG} + 1.58 \text{AG} + 1.33 \text{BL} + 0.10 \text{CRL} + 1.52 \text{DPN} + 1.94 \text{DHK} + 0.29 \text{DPH} + 0.88 \text{HW} + (-0.47) \text{HH} \]

where \( Y_i = \) body weight in kg

Using the body measurements individually in simple linear regression equation model gave \( R^2 \) value of 61.57, 55.15, 27.12, 16.65, 10.55, 35.21, 28.69, 37.53 and 27.92 per cent for HG, AG, BL, CRL, DPN, DHK, DPH, HW and HH, respectively. Hence it was found that in KF cows HG or AG alone can be used to predict body weight with reasonable accuracy. The prediction equations suggested as follows;

\[ Y_i = (-681.87) + 2.19 \text{HG} + 1.58 \text{AG} + 1.33 \text{BL} + 0.10 \text{CRL} + 1.52 \text{DPN} + 1.94 \text{DHK} + 0.29 \text{DPH} + 0.88 \text{HW} + (-0.47) \text{HH} \]
\[ Y_1 = (-475.46) + 5.03 \text{ HG} \]
\[ Y_2 = (-296.00) + 3.55 \text{ AG} \]

Where \( Y_1 = \text{Body weight in kg} \)
\( \text{HG} = \text{Heart girth in cm} \)
\( \text{AG} = \text{Abdominal girth in cm} \)

In Murrah buffalo group the multiple linear regression model involving HG, AG, BL, CRL, DPN, DHK, DPH, HW and HH as independent variables gave \( R^2 \) value of 66.90 per cent. The prediction equation derived as follows;
\[ Y_2 = -611.70 + 1.69 \text{ HG} + 2.45 \text{ AG} + 1.50 \text{ BL} + 0.47 \text{ CRL} + 1.78 \text{ DPN} + (-1.10) \text{ DHK} + 3.36 \text{ DPH} + 0.02 \text{ HW} + (-1.77) \text{ HH} \]

Where \( Y_2 = \text{Body weight in kg} \)

In simple linear regression models, the \( R^2 \) value was higher when using HG (\( R^2=52.28 \)) or AG (\( R^2=56.56 \)) as independent variable as compared to other body measurements such as BL (\( R^2=26.78 \)), CRL (\( R^2=24.97 \)), DPN (\( R^2=18.64 \)), DHK (\( R^2=17.25 \)), DPH (\( R^2=25.45 \)), HW (\( R^2=25.54 \)) and HH (\( R^2=12.19 \)). Hence in buffaloes similar to KF cows, HG or AG alone gave fairly accurate prediction of body weight. The prediction equations suggested as follows;
\[ Y_2 = (-443.56) + 4.82 \text{ HG} \]
\[ Y_2 = (-557.25) + 4.70 \text{ AG} \]

Where \( Y_2 = \text{Body weight in kg} \)
\( \text{HG} = \text{Heart girth in cm} \)
\( \text{AG} = \text{Abdominal girth in cm} \)

So, body measurements (HG, AG, BL, CRL, DPN, DHK, DPH, HW and HH) are better predictor of body weight, as there is not much appreciable improvement in \( R^2 \) value by multiple regression equations. Contrary to the results obtained in this study, Singh et al. (1994) reported that body length (BL) and heart girth (HG) were the most accurate indicators of live weight in female Mehsana buffaloes, while Prasad (1994) observed that BCS, body measurements, HG and AG were effective for prediction of body weight. Contrary to the present findings, Satyanarayana and Murty (1981) reported chest depth as the better predictor of the live weight in buffaloes.

REFERENCES