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Original Research Article

A Study on some Body Measurements and Weight of Butana Cows in Northern Sudan

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Abstract: There is often a great need for livestock herdsmen to know how much their animals weigh. For many reasons that may include, management decision such as how much to feed, when to breed, determination of dosages of various medications and vaccines and most important is when to market, for slaughter. The objective of this study was to determine the accuracy of prediction of body weight from some body measurements such as the body length (BL), height at withers (HW) and heart girth (HG) for Butana cows. These measurements were obtained from Butana cows (n=34), in station is situated in the river Nile State to the North of Atbara town in the Northern Sudan. In the current study three mathematical models, linear, quadratic and cubic were used to estimate the relationship between body weight and body measurements. Cubic model provides the best prediction of these relationships. A significant ($P<0.01$) correlation was obtained between height at withers and body weight ($r=0.757$). Also the regression of body weight on height at withers had the highest coefficient of determination ($r2 = 0.574$) this study suggests that this variable would provide a good estimate for predicting live body weight rather than with the other body measurements for Butana cows.

Keywords: body length, height at withers, heart girth.

INTRODUCTION

Sudan is a mainly agricultural country with large development potentials, especially in agriculture and livestock production. The Ministry of Animal Resources (M.A.R.F., 2009) estimated that cattle population was 41.56 million heads. These represented 29.5% of the total livestock population in the country. Butana breed of Sudan are very similar morphologically to the zebu breeds of Asia. The predominant coat colors is red or dark red, the tongue, muzzle eyelids and around the coronet are black; light red with white may also exist (Maule 1990). Dewlap is well developed and runs down in front of the forelegs forming few folds (Mason and Maule 1960) and is prominent in both sexes. Most of them possess small and black horns although some animals are polled. They have well developed thoracic or cervico-thoracic humps, which are large, hanging over backwards. The humps are relatively large in males but small in the cows (Mason and Maule 1960; Epstein 1971).

There is often a great need for livestock herdsmen to know how much their animals weigh. Possible reasons overtime for this may include, management decision such as how much to feed, when to breed, determination of dosages of various medications and vaccines and most important is when to market either as weaner, growers or for slaughter (Singh *et al*, 1990). The present study was undertaken to investigate live weight and its related measurements of Butana cattle to body measurements.

MATERIALS AND METHODS

Location of Atbara research station:-

The station is situated in the river Nile State to the North of Atbara town in the Northern Sudan. It is located at 17˚-40˚ North latitude and 33˚-58˚ longitude at an altitude of approximately 345 meters above sea level.

Data collection and manipulation

Body measurements for 34 female Butana cows reared in Atbara Research station were taken, which include Body Weight (kg) designated as (BW), Heart Girth (cm) designated as (HG) (the body circumference of the thoracic cavity immediately behind the fore limbs), Body Length (cm) designated as

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(BL) (distance between the point of the shoulder to the point of ischium (pin bone) and Height at wither (cm) designated as (WH) from ground up to the highest point of the withers.

Fig: 1 Butana cow- Sudan

Data analysis

The Statistical package for social sciences (SPSS) statistical computer software (SPSS for windows release) was used to analyze the data. The collected data were described by mean, standard deviation, minimum and maximum. The relationship between live body weight and linear body measurements were estimated by simple and multiple regressions. Due to slightly low r^2 values obtained two other methods were used to estimate this relationship. These are the quadratic and cubic models.

RESULT

The average body length of the Butana cows was found to be 98.00 cm and it ranges between 83 and 107cm (Table, 1). A significant ($P<0.01$) correlation was obtained between body length and body weight ($r = 0.68$ and $r^2=0.46$) (equation**,** 1, I). The average height at withers of the Butana cows was found to be 120.07 cm and it ranged between 98 and 131 cm (Table, 1). A significant ($P<0.01$) correlation was obtained between height at withers and body weight ($r = 0.76$ and $r^2 = 0.57$) (equation**,** 1, ii). This correlation was even higher than the correlation between body length and body weight. The average heart girth of the Butana cows was found to be 159.5cm and it ranges between 144cm and 186cm (Table, 1). The results revealed A significant ($P<0.01$) correlation between heart girth and body weight ($r = 0.74$ and $r^2 = 0.54$) (equation**,** 1, iii). A high positive correlation was found between height at wither and heart girth (0.85) (Table, 2).

Table (1): Description of body weight and measurements of Butana cattle

Variable	*Mean ± SD*	*Minimum*	*maximum*
Mature Body weight (kg)	313.65±22.1	275	375
Body length (cm)	98.00±6.1	83	107
Height at Wither(cm)	120.07±6.9	98	131
Heart Girth(cm)	159.48±9.2	144	186

Table 2. Correlation matrix of body weight and body measurements of Butana cattle:-

Variable	*Body weight*	*Body length*	*Height at Wither*	*Heart girth*
Body weight	-	0.68**	0.76**	0.74**
Body length		-	0.64**	0.65**
Height at wither			-	0.85**
Heart girth				-

**≡ P<0.01

The equations generated using the three mathematical models:

(1) The Linear Model:- a) simple regression: $Y = a + b X$

Y = weight of animal (kg)

a = Intercept, (constant).

b = Slope, the regression coefficient the change in Y per unit change in x.

X= body measurements. (cm)

(i) Independent Variable = Body length

Body weight = 82.663+2.322 Body length ($r^2 = 0.46$)

(ii) Independent Variable = Height at withers

Body weight = 33.829 +2.349 Height at withers ($r^2 = 0.57$)

(iii) Independent Variable = Heart girth

Body weight = – 102.229 **+** 2.592 Heart girth ($r^2 = 0.54$)

b) multiple regression: $Y= a + b_1X_1 + b_2 X_2 + b_3 X_3$

(iv) Independent Variables = Body length; Height at withers

Body weight = – 99.03 +2.57 Body length + 1.02 Height at withers ($r^2 = 0.61$)

(vi) Independent Variables = Body length; Heart girth

Body weight = 15.97 + 1.55 Body length + 0.89 Heart girth ($r^2 = 0.55$)

(vii) Independent Variables = Height at withers; Heart girth

Body weight = – 92.31 + 2.87 Height at withers +0.396 Heart girth ($r^2 = 0.73$)

(viii) Independent Variables = Body length; Height at withers; Heart girth

Body weight = – 20.696 **+**1.074 Body length **+**3.011 Height at withers**-**0.836 Heart girth ($r^2 = 0.68$**)**

(2) Quadratic model: - $Y = b_0 + (b_1 X) + (b_2 X^2)$

Y = Body weight

b0 = Intercept, the value of Y at Zero X.

(b1, b2) = Slope, the regression coefficient the change in Y per unit change in X.

(i) Independent Variable = Body length

Body weight = 361.531 – 3.50 Body length + .030 (Body length**)** ^{2} ($r^2 = 0.47$)

(ii) Independent Variable = Height at withers

Body weight = 977.876 – 14.079 (Height at withers**)** **+** 0.0711(Height at withers**)** ^{2} ($r^2 = 0.65$)

(iii) Independent Variable = Heart girth

Body weight = 1107.01 – 12.670 (Heart girth) + **.**o48 (Heart girth**)** ^{2} ($r^2 = 0.55$)

(3) Cubic Model:- $Y = b_0 + (b_1 X) + (b_2 X^2) + (b_3 X^3)$

Y = Body weight

b_0 = Intercept, the value of Y at Zero X.

(b1, b2 and b3) = Slope, the regression coefficient the change in Y per Unit change in X.

(i) Independent Variable = Body length

Body weight = 253.488 – 0.0074 (Body length**)** ^{2} + 0001 (Body length) ^{3} ($r^2 = 0.47$**).**

(ii) Independent Variable = Height at withers

Body weight = 449.024 **+** zero (Height at withers**)** – 0.0531**(**Height at withers) ^{2} **+**.0004**(**Height at withers) ^{3} ($r^2 = 0.65$**).**

(iii) Independent Variable = Heart girth

Body weight = 685.856 – 4.8689 (Heart girth) + zero (Heart girth)^2 **- .**0001 **(**Heart girth) ^{3} ($r^2 = 0.55$).

DISCUSSION

According to the results of this study the comparable correlation was determined between live weight and body length ($r = 0.68$ and $r^2 = 0.46$). This result suggests that body length would not a good estimate for predicting live body weight in Butana cows. While the highest significant correlation was determined between live weight and height at withers ($r = 0.76$ and $r^2 = 0.57$). Would provide a good estimate for predicting live body weight in Butana cows, rather than with the other body measurements. This result agrees with Swanepoel (1984) who regarded height at withers as a good indication of growth in cattle. While disagree with Mäntysaari and Mäntysaari (2008) who regarded from single measurements, heart girth (HG) predicted body weight (BW) most accurately in Ayrshire cows. ($r^2 = 0.79$). Also disagree with Serkan and Yalcin (2009) who regarded heart girth was the best parameter of all for prediction of body weight in Brown Swiss. When heart girth and height at withers were considered together the coefficient of determination increased. ($r^2 = 0.73$). Height at withers and heart girth had the highest influence on body weight; this influence suggested that either of these variables or their combination would provide a good estimation for predicting live body weight of Butana cows, with more concentration on the H.W**.** This result was in line with Mäntysaari and Mäntysaari (2008) who regarded heart girth give better prediction for (BW). The result is also in line with Serkan *et al* (2009) who regarded heart girth was the best parameter of all for prediction of body weight in Brown Swiss. The r^2 value obtained from the equation contained body length, Height at withers and heart girth was found (0.68). This result is higher than (r^2 = 0.66), reported by Mäntysaari and Mäntysaari (2008) in Ayrshire cows. When the equation contained only heart girth (r^2 = 0.55), Was lower than finding of Serkan and Yalcin (2009) for Holstein cows (r^2 = 0.61). As mentioned above, early lactation high producing cows are unable to eat enough energy to meet their needs. The cows are therefore forced to use their body reserves and lose weight (Coffey *et al*., 2002). This leads to decrease in body condition score (BCS) and thus can affect the relationship between H.W and BW. This relationship also influences by pregnancy during lactation. In the current study the additional term of days in milk (DIM) in regression including linear term of H.W increased the accuracy of prediction of BW from body measurements for both first lactating and older cows. For cows the addition of BCS and DIM improved the accuracy equally. For cows addition of BCS gave no predictive benefit, but addition of DIM improved the fit slightly. It can be stated that the effect of DIM on BW of cows arise more from the changes in size and maturity than fatness.

In the current study three mathematical models, linear, quadratic and cubic were used to estimate the relationship between body weight and body measurements (equations, 1, 2 and 3) Cubic Model provide the best prediction of these relationships. This reflects the nonlinear relationship between body weight and the body measurements studied. The body measurements' remain constant after puberty whereas the body weight still changing due to pregnancy and loss of weight resulted from the negative energy balance in first stages of lactation and other physiological changes.

CONCLUSION AND RECOMMENDATIONS

Since the body measurements had high correlation with the body weight, this may be used as selection criteria. Earlier reports also indicated that selection based upon the body measurements should improve the meat production. However, further research is needed to investigate the relationship between the body weight with linear body measurements in same and other breeds of cattle in different regions of the country at different ages with maximum number of observations.

According to the results of this study, it could be concluded that live weight of Butana cattle can be predicted from some body measurements using linear, quadratic or cubic modle.

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