Vol 20 No 1, p 7-9

PREDICTION EQUATION FOR ESTIMATING LIVE BODY WEIGHT OF DROMEDARY CALVES

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ABSTRACT

Prediction of live body weight of dromedary calves was attempted through regression models utilising the body dimensions viz. body length, heart girth and height at withers. A total of 46 neonatal dromedary calves of 4 dromedary genotypes comprising 30 males and 16 females were measured up to 14 weeks of age. The breed and sex associated differences were non-significant (P>0.05). Eleven regression models viz., linear, logarithmic, inverse, quadratic, cubic, compound, power, S, growth, exponential and logistic and the three body dimensions were utilised. Heart girth appeared as the most reliable predictor of the body weight at this stage of life. The power regression equation gave the best fit (R^2 = 0.92) for the unique measurement of heart girth. Efforts were also made to derive the coefficients utilising the mean values and it was observed that most of the regression models explained the variability to the extent of ≥ 99%. The quadratic equation $\hat{Y}$= 18.9162 -0.6845 HG +0.011645 HG^2 and power equation $\hat{Y}$ = 0.0008684 ($HG^{2.44333}$) explained the variability to the extent of 99.7% and may be used for the precise estimation of body weight during early months of the life. However, looking at the requirement of estimation of unique live weight, it is recommended that the power equation $\hat{Y}$ = 0.0008684 ($HG^{2.44333}$) may be used as the most reliable one by the scientists, veterinarians and animal husbandry men for all practical purposes.

Key words: Body weight, camel, mathematical functions

Body weight is primarily an expression of the size, age and physiological development of the animals. The birth weight, growth rate and weight at different periods serve as a reliable aid in selection of animals. Higher birth weight of new born results in more growth and desire body weight at time of maturity. Precise knowledge of the body weight of dromedary calves is very essential in determining the dosage of drugs, computing nutrient requirements and in transportation and sale. During transfer of technology and while conducting field trials of nutritional experiments, estimation of body weight of the camel calves put-forth severe challenge. Further, in fairs or most of commercial settings animals are valued based on their body weight. Age of the animals or the body dimensions can be the criteria to predict the body weight of the animals (Yakubu *et al,* 2005; Mehta *et al,* 2010). Beniwal and Chaudhary (1983) studied the growth pattern in Bikaneri camels from birth to 30 months of age and developed a function to explain growth during this period. Wilson (1984) revealed relationship between body weight and body measurement in camels for prediction of body weight but the results were only reasonably acceptable. Khanna *et al* (1990) utilised the step wise multiple regression analysis and observed that the prediction for the first year of life was not satisfactory. Enevoldsen and Kristensen (1997) suggested that different models might be needed to predict body weight in different environmental conditions, body condition and breed. Mehta *et al* (2010) utilised cubic function to explain the growth of camel for the entire life time to the extent of 99.4%. However, the need to assign a unique body weight to the animals of the same age was felt while conducting the field trials of nutritional experiment. It was also observed that the prediction equation based on unique measurement of an animal and dedicated to the early stages of life when the body weight gain is very high (Mehta, 2008) is not available. Efforts were therefore directed to formulate suitable prediction equation for the estimation of body weight of individual animal utilising the variation in the body dimensions during the early months of life. The present study would serve as a useful practical tool for scholars, veterinarians, livestock farmers and rural development worker for precise estimation of live weight of camel calves for all practical purposes.

Materials and Methods

The data belonging to the dromedary calves of Bikaneri, Jaisalmeri, Kachchhi and Mewari breeds

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maintained at the National Research Centre on Camel, Bikaner were analysed. A total of 46 calves comprising of 16 female and 30 males were measured during February to June, 2009. These calves were initially provided free access to their mother's milk and thereafter two times suckling in a day. They were offered free access to groundnut haulm at two month of age. Body measurements viz., body length i.e. the distance between the point of shoulder corresponding to the outer and central tuberosity to the left humerus to the left tuber ischii, body height i.e. the distance from the ground to the withers and heart girth i.e. the circumference immediately posterior to the front leg, were taken at weekly intervals up to 14 weeks after proper restraining of calves in standing position on a leveled platform. Simultaneously the calves were weighed on electronic balance before feeding. The analysis of variance was carried out to study the effect of breed and sex on body weight. The linear, logarithmic, inverse, quadratic, cubic, compound, power, S, growth, exponential and logistic regressions were fitted to obtain a suitable prediction equation for body weight from different measurements and their mean values (SPSS 10.0).

Results and Discussion

The mean body weight, body length, height at withers and heart girth in two sex and the 4 genotypes of Indian dromedary viz., Bikaneri, Jaisalmeri, Kachchhi and Mewari calves are presented in Table 1. Since the effect of breed and sex on body weight at this stage was non-significant (P>0.01) so derivation of one prediction equation for both the sexes and all four genotypes was considered. Non-significant effect of genotype and sex in the age of dromedary has also been reported by Bhargava *et al* (1965) and Mehta *et al* (2010). However, Beniwal and Chaudhary (1983) reported relatively higher body weights for Bikaneri breed from birth to 30 month of age and Rathore (1986) and Khanna *et al* (2004) reported Bikaneri as the heaviest breed of camel. Contrarily Xue Hui-Wei and Zhao Xing-Xu (1999) found statistically non-significant effect of sex on live weight of neonates bactrian camels.

Eleven mathematical functions were tried to derive suitable prediction equation for dromedary calves for initial phase of life i.e. from birth to 14 weeks of age. Three predictor variables viz. body length, height at withers and heart girth were utilised. Most variability (R^2 = 0.92) was explained while using heart girth as the predictor variable and power regression equation. The body length was second in order with S regression equation (R^2 = 0.88) and height at withers was last in the row with power regression equation (R^2 = 0.78). Jawasrey and Khasawney (2007) also observed heart girth as a trait of utmost importance in the prediction of body weight from body measurements. Similarly, Thiruvankadan (2005) reported that higher association of body weight with chest girth was possibly due to a relatively large contribution to weight chest girth constituting bones, muscle and viscera. Hence, it is felt that under field conditions, where difficulty of proper animal restraining exists, heart girth alone would be sufficient for precise estimation of live weight.

Table 1. Mean ±SE values of live body weight (kg) heart girth, body length and height (cm) at wither of 4 genotype of dromedary camels.

Age (in week)	(N)	Length	Height	Heart girth	Body wt
1	15	64.13±0.74	109.46±1.20	81.4±1.08	41.06±1.14
2	19	68.94±0.97	114.57±1.28	87.84±1.23	49.26±2.06
3	21	72.09±1.05	117.57±1.26	93.52±1.61	55.38±2.20
4	25	75.32±1.03	118.8±1.17	97.2±1.47	61.24±2.28
5	27	78.29±1.04	121.44±1.11	101.88±1.54	68.37±2.48
6	30	80.43±0.97	123.6±0.79	103.46±1.17	72.36±2.40
7	33	83.57±0.96	125.18±0.78	105.72±1.16	77.36±2.52
8	34	85.52±0.90	127.41±0.78	108.02±1.00	81.58±2.46
9	38	86.73±0.84	129.39±0.76	110.7±0.976	88.5±2.23
10	37	89.16±0.78	130.81±0.87	114.10±0.91	94.08±2.43
11	39	91.53±0.81	133.66±1.07	118.23±0.97	99.76±2.40
12	33	92.69±0.93	133.03±1.11	118.6±0.91	101.81±2.91
13	26	93.00±1.06	133.88±1.20	119.69±0.95	102.34±2.87
14	14	99.35±2.03	136.5±1.63	124.21±1.16	113.28±4.20

Table 2. Regression models, R^2 value and constants for the estimation of body weight, from body measurement.

Model	R^2	b_0	b_1	b_2
Linear	0.888	-109.69	1.7769	
Logarithmic	0.870	-767.97	181.837	
Inverse	0.842	252.791	-18174	
Quadratic	0.898	26.3101	-.8540	.0125
Cubic*	0.898	26.3101	-.8540	.0125
Compound	0.921	6.0426	1.0241	
Power	0.923	0.0008	2.4607	
S	0.914	6.7018	-248.78	
Growth	0.921	1.7988	0.0238	
Exponential	0.921	6.0426	0.0238	
Logistic	0.903	0.4997	0.9617	

*b_3: not estimated

The mathematical functions used their R^2 values and the regression coefficients are presented in Table 2. The quadratic, cubic, compound, power, S, growth, and exponential and logistic gave $R^2 > 0.898$. Beniwal and Chaudhary (1983) utilised linear and exponential functions to explain the growth pattern in Bikaneri camels up to 30 month age and found linear growth best with value of R2 0.9412, however, the R^2 values obtained with linear model was 0.88 and that with the exponential was 0.92. Mehta *et al* (2010) utilised cubic regression and explained the variability to the extent of 99.4% but in present study it was observed that there was no improvement in the estimated trait even when going from 2nd power (quadratic) to the 3rd power as in case of cubic regression. Further, in both of the above reports age was utilised as the predictor variable which can not be unique to a particular animal. The power equation $\hat{Y} = 0.000794$ ($HG^{2.4607}$) may therefore be utilised for the purpose. Wilson (1984) proposed two formulae based on body measurements viz., chest girth, abdominal girth, shoulder height and linear regression of the girth alone but proposed that the results were only reasonably acceptable. Khanna *et al* (1990) utilised step- wise multi-regression analysis using heart girth alone and observed that the prediction of six month, two years and three years body weight was satisfactory but that of one year was not in line with the other three body weights. Efforts were also made to derive the coefficients utilising the mean values and it was observed that most of the regression models explained the variability to the extent of ≥ 99%. There was a significant improvement in R^2 value. The quadratic equation $Y= 18.9162 -0.6845\ HG +0.011645\ HG^2$ and power equation $\hat{Y} = 0.0008684$ ($HG^{2.44333}$) explained the variability to the extent of 99.7% and may be used for the precise estimation of body weight during early months of the life. However, looking at the requirement of estimation of unique live weight, it is recommended that the power equation $\hat{Y} = 0.000794$ ($HG^{.4607}$) may be used as the most reliable one by the scientists, veterinarians and animal husbandry men for all practical purposes.

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