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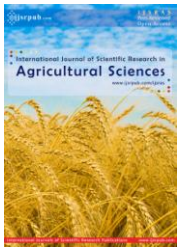


*Full Length Research Paper*

# Application of Morphometric Traits for Live Body Weight Estimation in Dhofari Calves

Salim Bahashwan

Salalah Livestock Research Station, P.O Box 1286, Postal code 211, Salalah, Sultanate of Oman
Tel.: +968-23225475, Fax: +968-23225798, E-mail: saleminiom@gmail.com

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**Abstract.** Morphometric traits measurements can be a vital tool for local farmers to make decisions of selection and breed improvement. Data of 108 records from 36 Dhofari calves aging from one month to 12 months old were used in this study. Morphometric traits of wither height (WH), body length (BL), heart girth circumference (HGC) and abdomen girth circumference (AGC) for the calves, males and females were determined to be significant ($P<0.05$) with age. Analysis showed significant ($P<0.05$) relationship between morphometric traits and LBW with highest correlation coefficient for HGC of 95.70%. Female claves LBW relationship with morphometric traits was highest for HGC with correlation coefficient of 97.00% and males for WH with correlation coefficient of 94.10%. Linear regression analysis of morphometric traits to estimate LBW found significant ($P<0.05$) differences between predicted equations with best derived equation was based on HGC to predict LBW with coefficient of determination $R^2$ =0.915. Analysis showed average actual weight (175.00 ±0.21 kg), derived equation predicted weight (175.59 ±0.44 kg) and Dalton tape weight (198.00 ±0.23 kg) no significance ($P>0.05$) between the actual and predicted weights but significant ($P<0.05$) difference with Dalton weighing method with best method for HGC based predicted equation. Analysis of 11 different types of regression derived equations for the prediction of LBW of Dhofari calves showed no significant ($P>0.05$) difference between their coefficient of determination $R^2$ which suggested the use of the proposed linear regression derived equation to be the best fit for that objective.

**Keywords**: Correlations, Dhofari calves, Live body weight (LBW), Morphometric traits, Regression and prediction.

## 1. INTRODUCTION

Most farmers and animal keepers in Sultanate of Oman raise their cattle using traditional systems accumulated through time and inherited from their forefathers. There are only 2.47% (7453) cattle in Oman raised in modern farms and about 2.51% (4380) cattle in Dhofar raised in modern farms (Anonymous, 2005). Therefore, it is important to study the morphometric traits of Dhofari calves for the purpose of finding out a simple measuring accurate way for predicting live body weight (LBW) for animal keepers in Oman as they lack the modern weighing machines and knowledge. Different breeds of cattle have different morphometric trait measurements and the use of calibrated weighing bands such as Dalton is not common in the developing countries as it is in the developed countries because their calibration was based on temperate breeds of cattle (Musa et al., 2011). The use of morphometric traits to predict LBW can be important to make selection and cull decisions for the local famers as it can be a relatively low cost, high accuracy and consistency (Musa et al., 2011). Morphometric traits in some cases can be more reliable than modern weighing machines as the later can give biased measurements caused by gut fullness (Obike et al., 2010). Body measurements that are used to predict LBW may affect its determination directly and indirectly (Yakubu et al., 2012). Researchers investigated different morphometric traits to predict LBW but most of them found HGC to be the best trait for that objective (Heinrichs et al., 1992). Regression equations must be determined for all beef breeds for different countries and regions (Caglar et al., 1993). Therefore, it is vital to find out and study the morphometric traits of Dhofari calves in order to derive the most accurate linear regression equation for LBW prediction.

## 2. MATERIALS AND METHODS

### 2.1. Data

Data of 108 morphometric trait records from 36 Dhofari calves native breed aging from one month to 12 months old were randomly collected at Salalah

Livestock Research Station in the south region of Sultanate of Oman during the year of 2014. Morphometric traits collected were wither height (WH), body length (BL), heart girth circumference (HGC), and abdomen girth circumference (AGC) using a plastic tape. Live body weights (LBW) of calves were taken using electronic weighing scale and Dalton weighing tape. Data were taken according to age ($1^{st}$ -$12^{th}$ month), whole calves and sex (male, female). Studied calves belong to the Dhofari indigenous breed of cattle located at Salalah Livestock Research Station located at Salalah city south region of Sultanate of Oman. Salalah city lies between a latitude of 17° 01N and longitude of 54° 16 E and 17 meter above sea level with a hot summer season (April – June) with a range temperature between 26 - 30° Celsius.

### 2.2. Housing and Feeding

Calves were kept with their relative dams after parturition for 5-7 days to suckle colostrum. After that they were kept separately in special pens during the day time after suckling from the dams and they rejoined the dams in the evening to suckle again. A commercial concentrate of 18% crude protein of about 100-500 gram during the first 3 months of their age was given gradually to them during the day with an *ad libitum* Rhodes grass hay (*Chloris gayana*) and the quantity was increased to 750-1000 gram as they moved from 6 to 12 months of age. Water and mineral blocks were given as *ad libitum*. Calves were housed in pens fenced by steel pipes. They were half shaded with one part concrete ground facilitated with feeders and water supply and the other non-concrete for exercise and sun exposure. Pens were well ventilated with wide windows and fans. All calves used in this study were vaccinated against common regional diseases and were in good health condition.

**Table 1:** Dhofari calves average morphometric traits (mean ±SE) at different ages.

| Age(months) | WH(cm)* | BL(cm)* | HGC(cm)* | AGC(cm)* | LBW(kg)* |
|---|---|---|---|---|---|
| 1-3mo | 90.56 ±0.55 | 90.61 ±0.87 | 108.94 ±84 | 112.89 ±0.91 | 97.86 ±1.91 |
| 3-6mo | 97.50 ±0.69 | 100.47 ±0.99 | 115.42 ±1.06 | 119.97 ±1.13 | 122.53 ±2.78 |
| 6-12mo | 108.83 ±0.77 | 110.33 ± 1.10 | 134.11 ±0.89 | 137.14 ±1.11 | 186.39 ±3.28 |

*values of WH,BL, HGC, AGC and LBW are significant ($p<0.05$) with Age.
WH= wither height. BL= body length. HGC= heart girth circumference. AGC= abdomen girth circumference. LBW= live body weight.

**Table 2:** Dhofari calves morphometric traits correlation coefficient with live body weight(LBW)

| Trait | LBW | WH | BL | HGC | AGC |
|---|---|---|---|---|---|
| LBW | 1.00* | .934* | .879* | .957* | .924* |
| WH | | 1.00 | .875 | .905 | .894 |
| BL | | | 1.00 | .856 | .872 |
| HGC | | | | 1.00 | .952 |
| AGC | | | | | 1.00 |

*correlation values are significant ($p<0.05$) with LBW and highest for HGC.
WH= wither height. BL= body length. HGC= heart girth circumference. AGC= abdomen girth circumference. LBW= live body weight.

### 2.3. Statistical analysis

All data were analyzed using SPSS software version 19 (2010). Means, standard errors and comparison between the means were obtained using GLM procedure and Duncan test at alpha 5%. Morphometric traits differences according to age and sex were analyzed using GLM and Duncan test for significance. Same procedure was used to test significance between different weighing systems. Different derived equations for prediction of live body weight were analyzed using different types of regression analysis models. Comparisons between best goodness of fit equations were analyzed using coefficient of determination variance $R^2$. Relationship between live body weights and morphometric traits were estimated by correlation and regression using Pearson correlation method.

## 3. RESULTS AND DISCUSSIONS

Results (Table 1) show that different morphometric traits of Dhofari calves of WH, BL, HGC, AGC and LBW were significant ($P<0.05$) with age which was similar to those obtained by Musa et al. (2011) for Kenana cattle except for BL which was higher by 47% in the Dhofari calves. Researchers (Green et al, 1978) and (Aamir et al., 2010) have shown this as a result of skeletal development within a population which affected the morphometric traits through age.

Results (Table 2) show a significant (P<0.05) strong positive correlation between morphometric traits and LBW and the highest was for HGC with correlation coefficient (r = 0.957). This estimate was higher by 14% than obtained by (Alfonso et al., 2011) with American Brown Swiss cows. Similar trends were found by (Orheruata et al., 1988) in beef cattle and suggested an increase of muscle in meat with higher HGC measurements. Results (Table 3) show a significant (P<0.05) positive correlation between morphometric traits and LBW for both males and females through age. Results (Table 4) show significant (P<0.05) positive correlation of morphometric traits of female calves with LBW and highest coefficient was for HGC (r = 0.970). Results (Table 5) show significant (P<0.05) positive correlation of morphometric traits of male calves with LBW and highest coefficient was for WH (r = 0.941). However, there was no significant (P>0.05) difference between WH and HGC correlation coefficients in estimating LBW in male calves which suggested any one trait of them would give a close accurate LBW prediction. Results (Table 6) show different derived linear regression equations based on different morphometric traits of Dhofari claves to predict and estimate LBW with a significant (P<0.05) goodness of fit for all traits and highest for HGC ($R^2$ = 0.915). In (Figure 1) of Dhofari calves predicted LBW based on derived linear regression equation based on HGC showed excellent goodness of fit ($R^2$ = 0.915) compared to actual body weight. Results showed no significance (P>0.05) between actual live body weight and derived linear regression equation based on HGC (Table 7) but there was a significant difference between them and calves weight using Dalton tape weighing system. Further investigation was done to utilize other types of regression analysis to find out the proper derived equation to give a better goodness of fit (Table 8). Results (Table 8) showed no significance (P>0.05) between different types of regression derived equations based on HGC to estimate LBW which suggested the use of linear regression derived equation to give the most reliable and accurate predicted live body weight for the Dhofari calves.

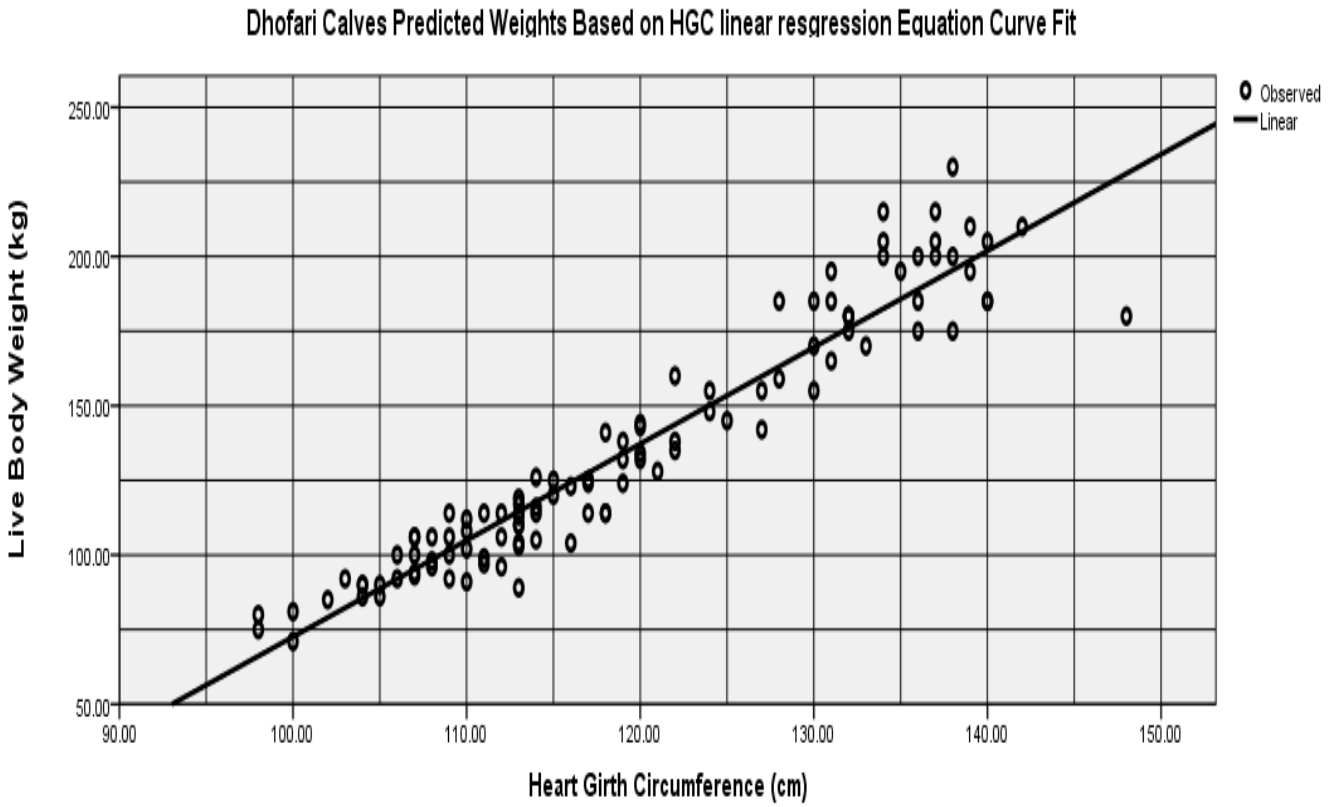


**Fig. 1:** Dhofari calves actual and predicted weights linear regression fit based on HGC.

**Table 3:** Dhofari calves males and females average morphometric traits (mean ±SE) at different ages.

| Age (month) | SEX | WH(cm)* | BL(cm)* | HGC(cm)* | AGC(cm)* | LBW(kg)* |
|---|---|---|---|---|---|---|
| 1-3mo | MALE | 91.18 ±0.68 | 92.06 ±1.22 | 110.65 ±1.12 | 114.47 ±1.08 | 103.53 ±2.37 |
| | FEMALE | 90.00 ±0.85 | 89.32 ±1.18 | 107.42 ±1.14 | 111.47 ±1.37 | 92.79 ±2.41 |
| 3-6mo | MALE | 98.71 ±0.59 | 102.76 ±1.40 | 117.47 ±1.26 | 121.65 ±1.50 | 130.35 ±3.39 |
| | FEMALE | 96.42 ±1.16 | 98.42 ±1.26 | 113.58 ±1.57 | 118.47 ±1.62 | 115.53 ±3.69 |
| 6-12mo | MALE | 110.75 ±1.15 | 111.75 ±1.80 | 134.81 ±1.63 | 136.19 ±1.92 | 190.00 ±5.86 |
| | FEMALE | 107.30 ±0.92 | 109.20 ±1.34 | 133.55 ±0.97 | 137.90 ±1.31 | 183.50 ±3.61 |

*morphometric traits are significant ($p<0.05$) for males and females with age.
WH= wither height. BL= body length. HGC= heart girth circumference. AGC= abdomen girth circumference. LBW= live body weight.

**Table 4:** Dhofari Female calves morphometric traits correlation coefficient TO live body weight(LBW)

| Trait | LBW | WH | BL | HGC | AGC |
|---|---|---|---|---|---|
| LBW | 1.00* | .929* | .889* | .970* | .945* |
| WH | | 1.00 | .897 | .911 | .919 |
| BL | | | 1.00 | .894 | .916 |
| HGC | | | | 1.00 | .958 |
| AGC | | | | | 1.00 |

*correlation values are significant ($p<0.05$) with LBW and highest for HGC.
WH= wither height. BL= body length. HGC= heart girth circumference. AGC= abdomen girth circumference. LBW= live body weight.

**Table 5:** Dhofari male calves morphometric traits correlation coefficient to live body weight(LBW)

| Trait | LBW | WH | BL | HGC | AGC |
|---|---|---|---|---|---|
| LBW | 1.00* | .941* | .865* | .938* | .902* |
| WH | | 1.00 | .846 | .901 | .876 |
| BL | | | 1.00 | .810 | .830 |
| HGC | | | | 1.00 | .949 |
| AGC | | | | | 1.00 |

*correlation values are significant ($p<0.05$) with LBW and highest for WH and HGC.
WH= wither height. BL= body length. HGC= heart girth circumference. AGC= abdomen girth circumference. LBW= live body weight.

**Table 6:** Dhofari calves Line regression analysis for the predicted equations based on morphometric traits with coefficient of determination($R^2$)

| Trait | PREDICTED EQUATION | $R^2$ |
|---|---|---|
| WH | Y = -304.69+(WH * 4.45) | .873* |
| BL | Y = -224.57+(BL * 3.59) | .773* |
| HGC | Y = -250.77 + (HGC * 3.23) | 0.915* |
| AGC | Y = -252.08 + (AGC * 3.14) | .854* |

*predicted equations $R^2$ are significant ($p<0.05$) with morphometric traits with best fit for HGC.
WH= wither height. BL= body length. HGC= heart girth circumference. AGC= abdomen girth circumference. LBW= live body weight.

**Table 7:** Dhofari calves average (mean ±SD) weights based on method of weighing (scale weight, predicted line regression equation and Dalton)

| Method | WEIGHT (kg) |
|---|---|
| SW | 175.00 ±0.21 [a] |
| PE | 175.59 ±0.44 [a] |
| DALTON | 198.00 ±0.23 [b] |

*Means with different subscripts ([a] and [b]) are significant at $p<0.05$.
SW= scale weight. PE= predicted weight.

**Table 8:** Different Regression Equations to predict LBW based on HGC with coefficient of determination $R^2$

| Type | Regression Equation | $R^2$ |
|---|---|---|
| Linear | LBW=-250.77+(3.23*HGC) | 0.914 [a] |
| Quadratic | LBW= -171.98+(1.92*HGC)+(0.0054*HGC*HGC) | 0.914 [a] |
| Cubic | LBW= -171.98+(1.92*HGC)+(0.0054*HGC*HGC)+(0*HGC*HGC*HGC) | 0.914 [a] |
| Growth | LBW= EXP(2.051+0.024*HGC) | 0.924 [a] |
| Compound | LBW= 7.77*(1.024)^HGC | 0.924 [a] |
| Logarithmic | LBW= -1722.48+388.86*LN(HGC) | 0.909 [a] |
| S - Curve | LBW= EXP(7.74+(-340.30/HGC)) | 0.929 [a] |
| Exponential | LBW= 7.77*EXP(0.024*HGC) | 0.924 [a] |
| Inverse | LBW= 526.27+(-46221.85/HGC) | 0.900 [a] |
| Power | LBW= 0.00016*HGC^2.85 | 0.929 [a] |
| Logistic | LBW= 1/(0+0.129*0.98^HGC) | 0.924 [a] |

*values with same subscript ([a]) are not significant ($p>0.05$)
LBW= live body weight. HGC= heart girth circumference.

## 4. CONCLUSION

Linear regression derived equation based on HGC to predict LBW for Dhofari calves can be the most easy simple straight forward practical and affordable method for the local farmers and animal keepers in Sultanate of Oman.

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Salim Bahashwan is a researcher at Salalah Livestock Research Station (Ministry of Agriculture and Fisheries, Sultanate of Oman) with an experience of 15 years in cattle and dairy products research work. Experienced in laboratory analysis for dairy, feed and ration formulation skills. Held certificates of experience from private and government sectors in Oman and outside the country. Experienced in writing scientific papers, reports and data for national and international scientific journal publishing. Practical expertise in carrying out national agricultural surveys, questionnaires, censuses and field data collection and inputting. Great practical knowledge of computer software (Microsoft word, Microsoft excel, Microsoft PowerPoint, internet etc). Directed many educational extension courses for farmers, farm animal owners and rural women communities in Dhofar. Participated in the national agriculture census using latest technology such as PDA and GPS equipments. Organized and wrote annual, half-annual and abstracts of scientific papers at "Salalah livestock research station". Participated in organizing and managing the annual agriculture gallery during the monsoon season in Salalah city. Participated in many scientific meetings, conferences and discussions in Dhofar and Muscat. Participated in research with the college of agriculture of the Sultan Qaboos University. Participated in the third international conference of camel's research at Muscat. Published several research papers in research journals such as "Netjournals of agriculture science". Have a Bachelor degree of animal science from Sultan Qaboos University (BS) 1994-1998 in Muscat with honors.