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Relations Between Birth Weight and Some Body Measurements in Anatolian Black Cattle Calf Grown in Breeding Conditions

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BW: birth weights
WH: withers height
RH: rump height
CG: chest girth
CD: chest depth
BL: body length
FWG: front wrist girth

ABSTRACT

In this study, it was aimed to investigate the relationship between birth weights and body measurements of Anatolian Black cattle and to develop linear regression equations to estimate calf birth weights. The animal material of this study, 108 Anatolian Black Cattle were used which were born in 2018. Those animals came from 21 different farms which are located in Osmansin village, Çamlıdere district of Ankara province. In study, birth weights (BW), withers height (WH), rump height (RH), chest girth, (CG), chest depth (CD), body length (BL) and front wrist girth (FWG) were obtained in the order of; 14.451±0.397 kg, 57.775±0.347 cm, 59.843±0.382 cm, 53.510±0.517 cm, 24.137±0.281cm, 49.608±0.581 cm, 7.123±0.068 cm. The effect of calf gender was statistically significant only in FWG ($P<0.05$), but not statistically significant in other characteristics. The effect of age maternal WH, RH, CG and CD values were significant ($P<0.05$), on the other hand, there is no significant ($P>0.05$) effect BW, BL and FWG. The highest correlation was found between BW and CG ($r=0.808$) however, the lowest correlation was found between BW and FWG ($r=0.467$).In addition, the highest correlation between body measurements was found between WH and RH with a value of 0.965. Regression analysis was performed between the chest girth and the live weight measurement, which is the measurement value that gives the highest correlation coefficient so that the live weight estimate can be made with the body weight parameters; $BW = -15.53 + 0.5577\ CG$ ($R^2 = 65.3\%$) formula was obtained.

1. Introduction

Since thousands of years, cattle have become an important place in the feeding of mankind through meat, milk, skin, fertilization and work power and fulfillment of their some other needs (Boztepe et al 2015). According to FAO 2016, about 20 % of world meat production and 82.5 % of milk production are provided by cattle (FAO 2018).

In many countries, organizations have been organized for conservation or protection of native gene resources and this field has become a discipline. In this area, many types of researchs have also carried out in Turkey. In this contexts, the most adapted to the inefficient conditions in Central Anatolia and the domestic cattle population with the highest number, Anatolian Black cattle come to the fore. Anatolian Black cattle is one of our native breeds which are small in size and low in milk yield. This breed, which can survive, fertilize and even give a few liters of milk, must be conserved inefficient pasture and farm conditions of Turkey (Boztepe et al 2015).

Birth weight is used as the initial measure of growth in mammals. Birth weight is the easiest and reliable measure of prenatal growth and an important factor affecting postnatal growth and development (Akbulut et al 2001). Birth weight is not taken into account by most of the farmers because of its limited economic importance (Kaygısız 1998). This is not only a sign of adult weight of the breed but also important for prediction of the daily weight gain and making the feeding programmes (Tüzemen and Yanar 2013).

Relationships between body measurements and body weights in cattle can vary depending on many factors such as age, gender and nutritional level of the animal. Therefore, the regression equations should be prepared separately for cattle breeds grown in different countries and regions (Şekerden and Aydın 1992).

There is a limited number of studies including birth weight and body measurements of Anatolian Black

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cattle (Anonymous 2004, Demirhan and Tekerli 2008, Kılıçel and Tepeli 2014). In this study, it was aimed to investigate the relationship between birth weights and body measurements of Anatolian Black cattle and to develop linear regression equations to estimate birth weights of calves.

2. Materials and Methods

The animal material of this study was produced by Anatolian Black calves born in 2018 which are located in Osmansin village, Çamlıdere district of Ankara province which takes place within the scope of "Conservation and Sustainable Use of Pets Genetic Resources Project" conducted by General Directorate of Agriculture Research and Policies (TAGEM). The birth weight and body measurements of 108 calves were taken from 21 different farms.

The birth weights of calves used in the study were measured by a scale sensitive to 200 gr. Birth weights and body measurements were taken within 24 hours after birth. The measurements of withers height, rump height, chest girth, chest depth, body length, and front wrist girth were measured by measuring stick and tape measure.

The baseline statistical values of obtained body measurements and birth weights were determined. Variance analysis belonging to the measurement parameters were done. The difference between the averages was tested by the "Tukey Multiple Comparison" test. The relationship between birth weight and body measurements was determined by "Pearson Correlation". For determine the birth weight prediction with body measurements, regression analysis was performed between the important parameters. Statistical calculations were done with "Minitab 16" package program.

3. Results and Discussion

Averages and standard error values for birth weight and body measurements are given in Table 1. The values of birth weight and body measurements according to maternal age are given in Table 2. The change graph of the birth weight according to the maternal ages is shown in Figure 1. Relations between birth weight and body measurements are presented in Table 3 with simple correlations. Also, the correlation coefficients between birth weight and body measurements according to gender are presented in Table 4 and Table 5.

Table 1
Mean values of birth weight and body measurements (Average±SEM)

Measurements	Female (n=51)	Male (n=57)	Total (n=108)	P-Value (Gender)
Birth weight (kg)	14.451±0.397	15.053±0.313	14.769±0.250	0.412
Withers height (cm)	57.775±0.347	58.211±0.443	58.005±0.285	0.672
Rump height (cm)	59.843±0.382	60.342±0.446	60.106±0.296	0.612
Chest girth (cm)	53.510±0.517	55.070±0.493	54.333±0.363	0.063
Chest depth (cm)	24.137±0.281	24.342±0.313	24.245±0.211	0.962
Body length (cm)	49.608±0.581	49.000±0.578	49.287±0.410	0.385
Front wrist girth (cm)	7.123±0.068^{b}	7.649±0.076^{a}	7.401±0.057	***0.001***

The difference between the same line which has shown with different letters are statistically significant (P<0.05)

Table 2
Mean values according to the maternal age of birth weight and body measurements (Average±SEM)

Maternal age	N (104)	Birth weight (kg)	Withers height (cm)	Rump height (cm)	Chest girth (cm)	Chest depth (cm)	Body length (cm)	Front wrist girth (cm)
2	6	13.750±1.0^{a}	54.667±1.1^{b}	57.000±1.2^{b}	51.000±1.4^{b}	22.667±0.8^{ab}	48.167±1.8^{a}	7.250±0.2^{a}
3	12	12.792±0.7^{a}	56.250±0.8^{ab}	58.333±0.8^{ab}	51.667±1.0^{b}	22.333±0.6^{b}	48.500±1.3^{a}	7.021±0.2^{a}
4	18	14.389±0.6^{a}	58.056±0.6^{ab}	60.333±0.7^{ab}	53.667±0.8^{ab}	23.778±0.5^{ab}	49.722±1.0^{a}	7.264±0.1^{a}
5	15	15.733±0.6^{a}	59.533±0.7^{a}	61.733±0.7^{a}	55.867±0.9^{a}	25.133±0.5^{a}	48.867±1.1^{a}	7.567±0.1^{a}
6	22	15.250±0.5^{a}	57.705±0.6^{ab}	59.682±0.6^{ab}	55.455±0.8^{a}	25.114±0.4^{a}	49.591±0.9^{a}	7.614±0.1^{a}
7	9	15.889±0.8^{a}	58.889±0.9^{ab}	60.889±1.0^{ab}	55.333±1.2^{a}	24.778±0.7^{ab}	50.778±1.5^{a}	7.361±0.2^{a}
8	14	15.286±0.7^{a}	59.500±0.7^{a}	61.393±0.8^{a}	55.071±0.9^{a}	24.857±0.5^{a}	49.429±1.2^{a}	7.661±0.2^{a}
9	8	15.125±0.9^{a}	58.375±1.0^{ab}	60.625±1.1^{ab}	54.625±1.3^{ab}	24.375±0.7^{ab}	48.375±1.6^{a}	7.281±0.2^{a}
P-Value (Maternal age)		0.055	*0.003*	*0.009*	*0.013*	*0.002*	0.919	0.053

The difference between the same column which has shown with different letters are statistically significant (P<0.05)

Table 3
Correlation coefficients between birth weight and body measurements on calves

Factors	Values	Withers height	Rump height	Body length	Chest girth	Front wrist girth	Chest depth
Rump height	Correlation rate	**0.965**					
	P-Value	*0.001*					
Body length	Correlation rate	0.484	0.488				
	P-Value	*0.001*	*0.001*				
Chest girth	Correlation rate	0.698	0.686	0.458			
	P-Value	*0.001*	*0.001*	*0.001*			
Front wrist girth	Correlation rate	0.536	0.486	0.236	0.666		
	P-Value	*0.001*	*0.001*	*0.014*	*0.001*		
Chest depth	Correlation rate	0.527	0.482	0.203	0.638	0.556	
	P-Value	*0.001*	*0.001*	*0.035*	*0.001*	*0.001*	
Birth weight	Correlation rate	0.666	0.676	0.534	**0.808**	**0.467**	0.557
	P-Value	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*

Table 4
Correlation coefficients between birth weight and body measurements on female calves

Factors	Withers height	Rump height	Body length	Chest girth	Front wrist girth	Chest depth
Rump height	**0.965****					
Body length	0.345*	0.355**				
Chest girth	0.634**	0.606**	0.370**			
Front wrist girth	0.443**	0.385**	0.161^{OD}	0.587**		
Chest depth	0.384**	0.382**	0.065^{OD}	0.671**	0.526**	
Birth weight	0.620**	0.627**	0.487**	**0.871****	0.371**	0.572**

***(P<0.01)* **(P<0.05)*

Table 5
Correlation coefficients between birth weight and body measurements on male calves

Factors	Withers height	Rump height	Body length	Chest girth	Front wrist girth	Chest depth
Withers height	**0.966****					
Body length	0.591**	0.597**				
Chest girth	**0.754****	0.750**	0.582**			
Front wrist girth	0.633**	0.578**	0.402**	0.710**		
Chest depth	0.607**	0.541**	0.310*	0.626**	0.646**	
Birth weight	0.732**	0.737**	0.616**	**0.747****	0.568**	0.558**

***(P<0.01)* **(P<0.05)*

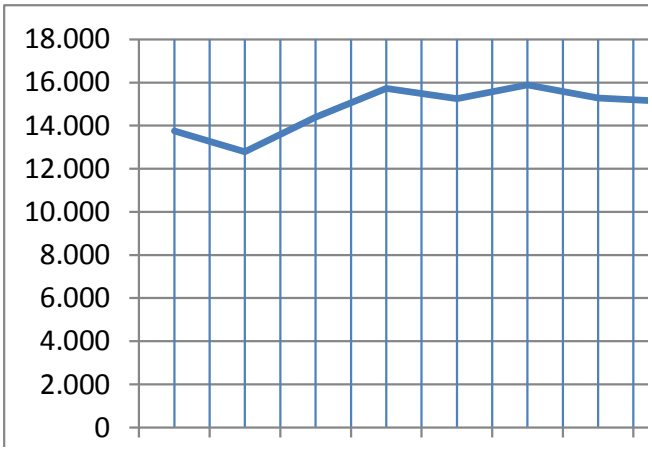

Figure 1
According to the maternal age of birth weight (kg)

In order to make the live weight estimation with body size parameters, By making regression analysis performed between the live weight measurement and the chest girth which is the measurement value that gives the highest correlation coefficient following formula was obtained.

Weight = - 15.53 + 0.5577*Chest Girth (R-Sq = 65.3%)

A linear regression model of the live weight and chest girth is shown in Figure 2.

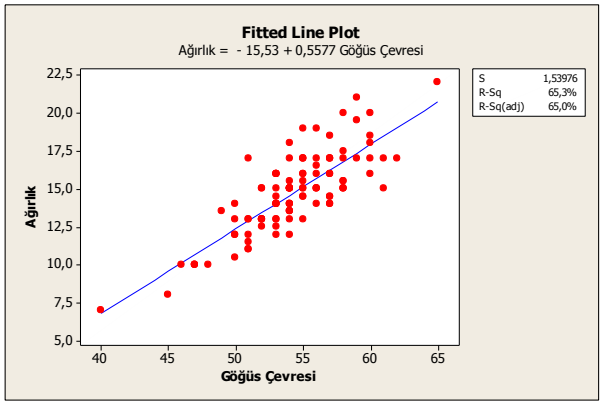

Figure 2
Linear regression model between birth weight and chest girth

3.1. Birth Weight

In this study, the average birth weight was found 14.769 kg. This value was found lower than the values reported in Eker (1953), Anonymous (2004), Demirhan and Tekerli (2008), Anonymous (2009) and Kılıçel and Tepeli (2014) for Anatolian Black cattle. It was concluded that the lower value determined in this study could result from maintenance and feeding conditions in the breeder conditions. It can be said that higher values of the results of other studies may be caused by the difference of the institute and the university environment.

In this study, average birth weight in female and male calves was found 14,451 kg and 15,053 kg respectively. The difference is not found statistically significant (Table 1). In other studies conducted with Anatolian Black Cattle, it was reported that the effect of gender on birth weight was not found significant (P>0.05) by Kılıçel and Tepeli (2014) while it was found statistically significant (P<0.05) by Demirhan and Tekerli (2008). Also, in Anonymous (2004) it was reported that the birth weight of Anatolian Black Cattle male calves was higher than that of female calves. According to the literature reports carried out with other breeds, the effect of gender on birth weight was found statistically significant (P<0.01) by Akbulut et al (2001), Koçak et al (2008), Tilki et al (2008), Sakar and Zülkadir (2009) and also statistically significant (P<0.05) by Ertuğrul (1993), Aydın and Diler (2007), Kaygısız et al. (2011). On the other hand, it was not found statistically significant (P>0.05) by Kaygısız and Köse (2007).

The effect of gender on birth weight is more important for beef cattle farms. Stock farming is carried out mostly by male animals. It is well known that male animals having high birth weight provide more benefits in the stock farming. In the Anatolian Black breed animals are also required to have a high birth weight for fattening.

3.2. Body Measurement

In the current study, the values of WH, RH, CG, CD, BL, and FWG were obtained 57.775±0.347 cm, 59.843±0.382 cm, 53.510±0.517 cm, 24.137±0.281cm, 49.608±0.581 cm and 7.123±0.068 cm respectively (Table 1). When these values are compared with other literature reports; WH was found higher than the values reported by Demirhan and Tekerli (2008) but lower than the values reported by Kılıçel and Tepeli (2014). BL, CG, and CG values were found lower than the values reported by both researchers. Also, WH, RH, CG, and CG values were found lower when compared with other native breeds.

In this study, according to the gender WH, RH, CD, and BL were not found statistically significant (P>0.05). WH, BL, and CG were not found statistically significant (P>0.05) by Demirhan and Tekerli (2008) with Kılıçel and Tepeli (2014), while CG was found statistically significant (P<0.05) by Demirhan ve Tekerli (2008). Özlütürk et al (2007) found WH, BL and CG statistically significant (P<0.01) in thr East Anatolian Red breed. When CG was found statistically significant (P<0.01) by Ünalan and Işık (2007), WH, BL, and CG were not found statistically significant (P>0.05) in the South Anatolian Red breed.

3.3. Maternal Age

In this study, heaviest birth weight values were obtained from calves born from 7-year-old cows when the lowest birth weight values were obtained from calves born from 3-year-old cows (Table 2). Birth weight values of calves born from cows up to the age of 7 show an increasing tendency but after 7-year-old they fall into a downward trend (Figure 1). The reason why the average birth weight of the calves born from 2-year-old cows is higher than 3 years old cows is thought due to the fact that 5 of the 6 calves born from 2-year-old cows are males.

The effect of maternal age on birth weight in this study was not statistically significant (P>0.05) (Table 2). It was found statistically significant (P<0.05) that the effect of parity on birth weight by Demirhan and Tekerli (2008) and the effect of maternal age on birth weight by Kılıçel and Tepeli (2014). According to the literature reports carried out with other breeds, it was reported that the effect of maternal age on birth weight was found statistically significant (P<0.01) by Akbulut et al (2001), Kaygısız et al. (2011), Kaygısız and Köse (2007), Özlütürk et al (2007), Koçak et al (2008), Tilki et al (2008) and statistically significant (P<0.05) by Ertuğrul (1993), Aydın and Diler (2007). On the other hand, it was not found statistically significant (P>0.05) by Sakar and Zülkadir (2009).

In this study, highest values of WH, RH, CG, and CD were obtained from calves born from 5-year-old cows, highest values of BL was obtained from calves born from 7-year-old cows and highest values of FWG was obtained from calves born from 8-year-old cows

(Table 2). As expected, the lowest values of WH, RH and BL were obtained from calves born from 2-year-old cows which are the youngest cows according to the maternal age and the lowest values of CD and FWG from 3-year-old cows. It was found in this study that the effect of maternal age on WH, RH, CG and CD values were statistically significant (P<0.05) while on BL and FWG values were not statistically significant (P>0.05). Demirhan and Tekerli (2008) reported that the effect of parity on WH and CG was statistically significant (P<0.01) however on BL and CG was not statistically significant (P>0.05). Kılıçel and Tepeli (2014) reported that the effect of maternal age on WH and CG was statistically significant (P<0.05) in cows given birth two or more. Özlütürk et al (2007) found that the effect of maternal age on WH, BL values of newborn calves was not statistically significant (P>0.05) but on CG value was statistically significant (P<0.05) in the East Anatolian Red breed. Ünalan and Işık (2007) reported that the effect of maternal age on WH, BL, CG and CG values of newborn calves were not statistically significant (P>0.05) in the South Anatolian Red breed.

3.4. Correlation Value

The highest correlation was found between BW and CG (r=0,808) and the lowest correlation was found between BW and FWG (r=0,467). Similarly it was reported by Dhangar and Patel (1990), Tüzemen et al (1993), Yanar et al (1995), Tüzemen et al (1995), Francis et al (2002) and Özlütürk et al (2006) who carried out similar study with different breeds that there was a high correlation between the values of chest girth and birth weight of calves. In addition, the highest correlation between body measurements was found between WH and RH with a value of 0.965.

Regression analysis was performed between the live weight measurements and chest girth which is the measurement value that gives the highest correlation coefficient in order to make the live weight estimation with body measurements. And the following formula was obtained.

$$BW = -15.53 + 0.5577\ CG\ (R^2 = 65.3\ \%)$$

This value was found similar with results reported by Tüzemen et al (1993), Yanar et al (1995), Tüzemen et al (1995), Ulutaş et al (2002), Özlütürk et al (2006), Yan et al (2009), Taşdemir et al (2011) and Mekparyup et al (2013) who carried out similar studies with different breeds. In order to increase the value (65.3 %) found in the study, it can be considered that the animal material should be increased in future studies.

3.5. Conclusion

In this study, birth weights and some body measurements and the relations between these measurements of Anatolian Black calves which are mostly grown on intensive conditions in the Osmansin village, Çamlıdere district, Ankara province were investigated.

The results of the survey in the research indicate that the birth weights of the calves are not at the desired level in the Anatolian Black cattle breed, which has a numerically important place in the Central Anatolian region. Regarding the findings, the breeding of the Anatolian Black cattle needs to be improved in terms of genetic, breeding and environmental conditions. The positive and highly significant (P<0.01) correlations between birth weight and total body measurements are positive results for selection studies.

It is thought that future studies could consider increasing number of animal material for getting more positive results. As a result, a recent study has shown that we can estimate the birth weight of calves with high accuracy using chest girth value in breeder conditions where there are no weighting possibilities.

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