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Original Research Article

Seasonal changes in clinical parameters of *Bos indicus*, *Bos taurus* and *Bos indicus x taurus* bulls raised on Zambian commercial farms

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The primary objective of the study was to assess the relationships of age, Scrotal circumference (SC), month and Body condition score (BCS) of *Bos indicus*, *Bos taurus* and *Bos indicus x taurus* bulls raised on Zambian commercial farms. This was a retrospective study involving 1007 bull breeding soundness data from January 2014 to November 2015. The bull population comprised of 314 *Bos indicus*, 139 *Bos indicus x taurus* and 554 *Bos taurus* bulls. There was a positive correlation between age and SC (r = 0.704, p<0.01). Breed had a weak positive correlation with SC and BCS (r = 0.230 and r= 0.113, respectively, p<0.01). The *Bos taurus* bulls had the largest SC compared to the *Bos indicus* and their crosses. There was a weak positive correlation between BCS and SC (p = 0.328, p<0.01), and negative correlations between month and SC, month and BCS (p =-0.214, and p =-0.448, respectively, p<0.01). About 50% of the variation in SC was explained by the change in age of the bull. In conclusion, it is important to consider the relationships of age, BCS, SC of different Zambian commercial breeds of bulls when selecting bulls for breeding programmes throughout the year.

Keyword: Age, breed, body condition score, scrotal circumference.

INTRODUCTION

In the tropics, breeding of beef cattle is based on natural mating using one or several bulls per head (Chacon et al., 1999). The bull must be fertile for efficient production of beef cattle bred by natural service under extensive management systems (Nichi et al., 2006). This fertility is affected by several factors such as age, nutrition, season, breed of the bull and their interactions (Vilakazi, 2003;Roberts et al. 2010; Menon et al. 2011; Lemma and Shemsu 2015).

Scrotal circumference (SC) in the bull is an indirect but confident indicator of testicular weight and sperm production and it is positively correlated with age, body weight, the total number of sertoli cells, quality of semen produced by the bull and age at puberty of the bulls' offspring (Chacon et al., 1999; Alexander, 2008). Breed is another important factor that accounts for the variation in SC between bulls of the same age and raised under the same conditions (Makarechian et al., 1985). The present study was carried out to assess the relationships of age, SC, month and BCS of *Bos indicus*, *Bos taurus* and *Bos indicus x taurus* bulls raised on Zambian commercial farms.

METHODOLOGY

Study design

This was a retrospective study based on the bull breeding soundness evaluation (BBSE) data from January 2014 to November 2015 obtained from Matobo Veterinary centre. However, the months of February and March were not included in the study as the BBSE was not done in the two

Table 1. Correlated relationships of age, month, body condition score scrotal circumference and breed in bulls

	SC	Age	Breed	BCS	Month
SC	1	0.704**	0.230**	0.328**	-0.214**
Age		1	0.027	-0.047	-0.01
Breed			1	0.113**	0.238**
BCS				1	-0.448**
Month					1

** Correlation is significant at 0.01 level.

months. A total of 1007 bulls were studied comprising 314 *Bos indicus*, 139 *Bos indicus x taurus* and 554 *Bos taurus*.

Scrotal circumference measurement

Scrotal circumference was measured using a standard scrotal tape from the rear side of each bull. Testicles were gently forced to the bottom of the scrotum while making sure that they do not spread apart. The SC was measured by placing the measuring tape around the widest mid-scrotal point (Alexander, 2008).

Body condition scoring and Aging

Body condition was scored using a score from 1 to 5 as described by Penny, (2016);Sitali et al. (2016). A score of 1 denoted a very thin bull (poor), while 5 denoted an extremely fat bull (obese) and 3 as an average BCS (good). The age of bulls was obtained from the farmers records as this was clearly recorded by the farmer.

Statistical analyses

Data on age, month, BCS, breed and SC were entered into the Excel spread sheet and exported to SPSS version 20.0 for analysis. Descriptive statistics was performed for the entire bull population studied. Correlation coefficients were estimated among month, BCS, age, SC and breed. Differences at $p < 0.01$ were considered to be statistically significant.

RESULTS

Table 1 shows the correlation coefficients among SC, age, Breed, BCS and month. There was a positive correlation between age and SC. Bulls older than 72 months of age had the largest SC. Breed was positively correlated with SC. The *Bos taurus* bulls had the largest SC as compared to the *Bos indicus* and their crosses.

Figure 1 shows the relationship between age and SC. Scrotal circumference of bulls was seen to increase with advancement of the age. Figure 2 shows higher BCS values during the months of January to May compared to other months. The lowest values of BCS were recorded in the month of October. Figure 3 shows the relationship between month and SC. Higher SC values were obtained during the period between July to August while lower SC values were found between May and June. Figure 4 shows the relationship between breed and SC. The *Bos taurus* and *Bos indicus* bulls had higher SC values than their crosses.

DISCUSSION

Our study revealed that SC was positively correlated with age of the bull from the various commercial farms in the Zambian tropics. Scrotal circumference was seen to improve with the advancement of the age of the bull. The findings of our study are in agreement with Arteaga et al. (2001);Chacon et al. (2002);Guerra et al. (2013) in the sub-tropical and tropical regions of Canada and Costa Rica respectively. Chacon et al. (2002) reported a positive correlation between age and SC of the sires raised under tropical conditions with a correlation coefficient of 0.72. The findings are also in agreement with those of Barth and Ominski (2000) and Morris et al. (1989). Morris et al. (1989) found a correlation coefficient of 0.74 between SC and age; this is closer to the finding of 0.70 in our study while Sosa et al. (2009) found a positive correlation of 0.81 between SC and age in the American Wagyu sires that were studied.

The present study revealed that the higher BCS values were found during the months of January to May compared to other months. This could be due to the presence of fresh green pastures available in the months of January to May in Zambia, leading to the proper nourishment of the animals. A decrease was seen in June and a slight increase in the period between July and August. The lowest values of BCS were recorded in the month of October. Our findings are in agreement with Chacon et al. (1999); Moraes et al. (2007); Ndlovu and Muchenje (2009), who found that seasonal changes were associated with BCS in the tropical regions of Costa Rica, Brazil and South Africa respectively. Chacon et al. (1999) found higher values during the period of January to May and then BCS values started to decrease in June. In agreement with the findings of our study, Chacon et al. (1999) recorded the lowest seasonal BCS mean from

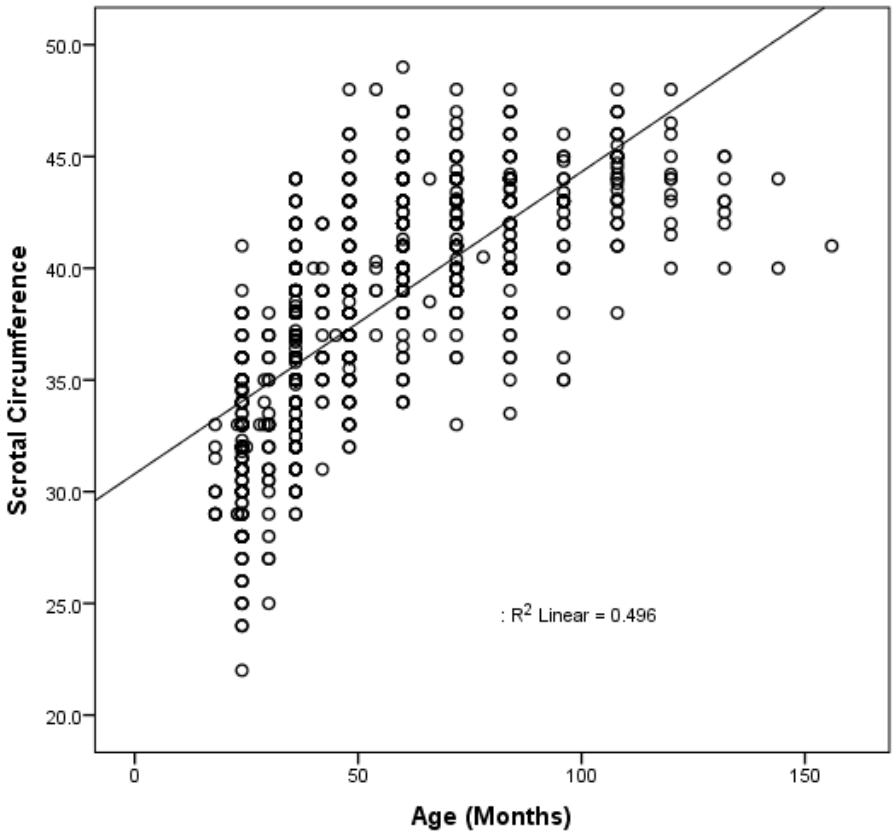

Figure 1: Relationship of Age and Scrotal circumference

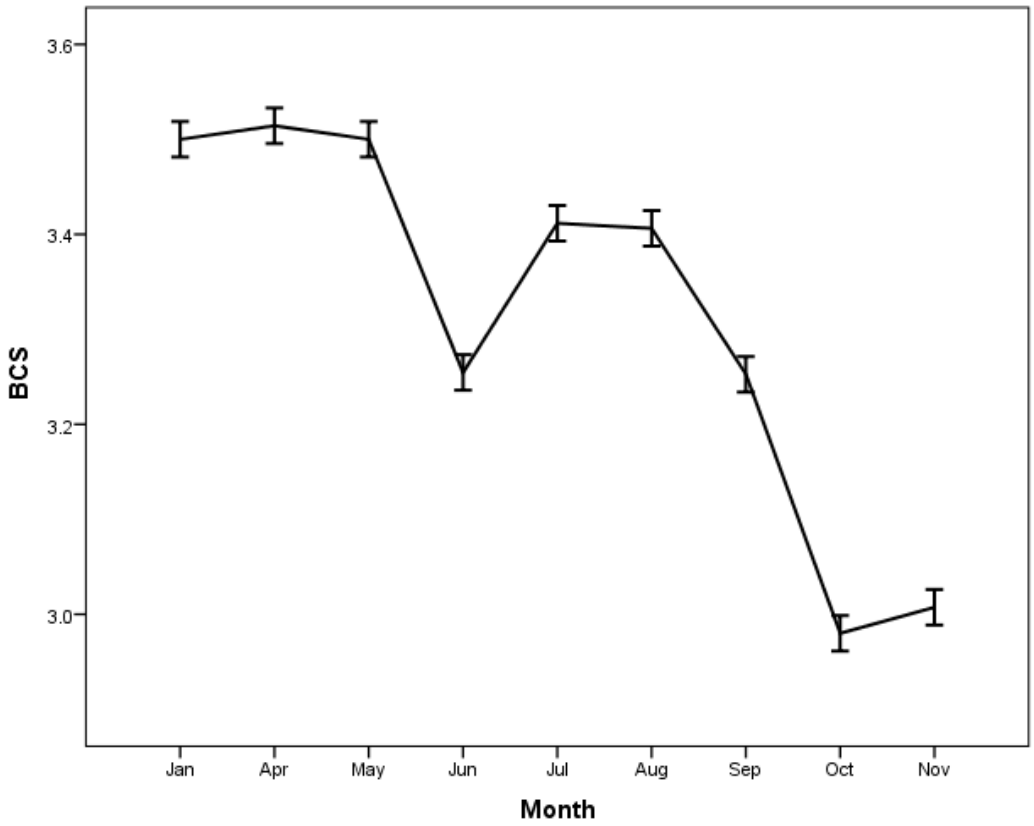

Figure 2: Relationship of Month and Body Condition Score

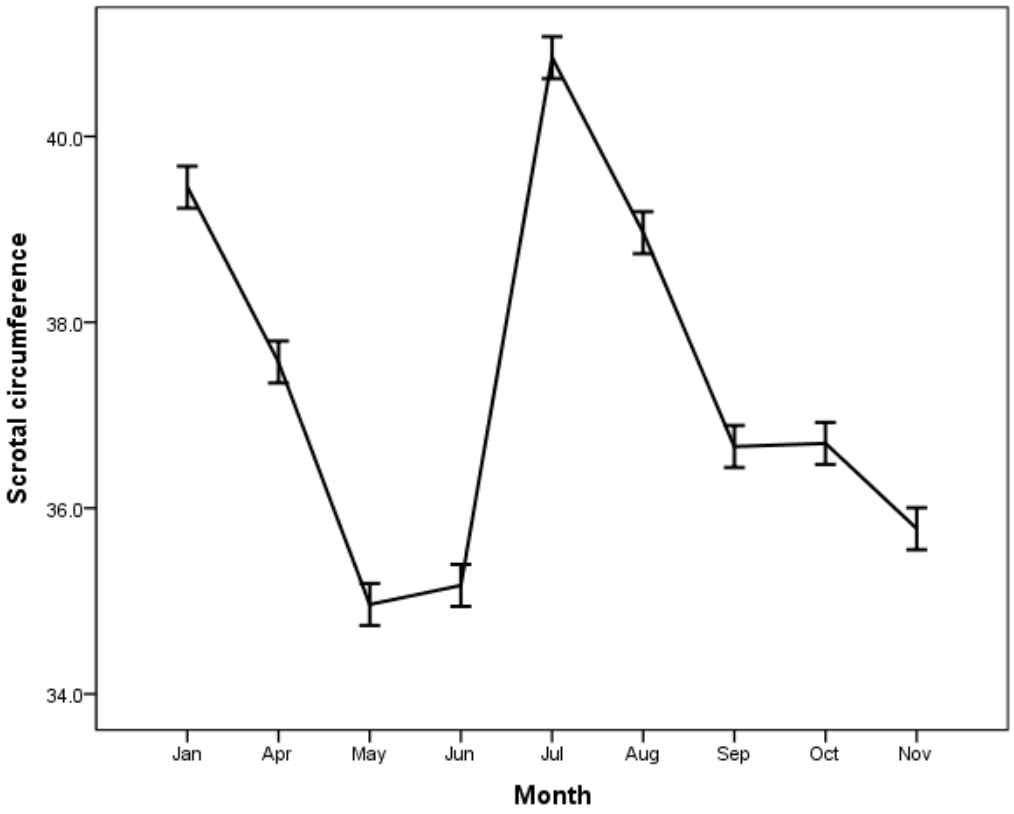

Figure 3: Relationship of Month and Scrotal circumference

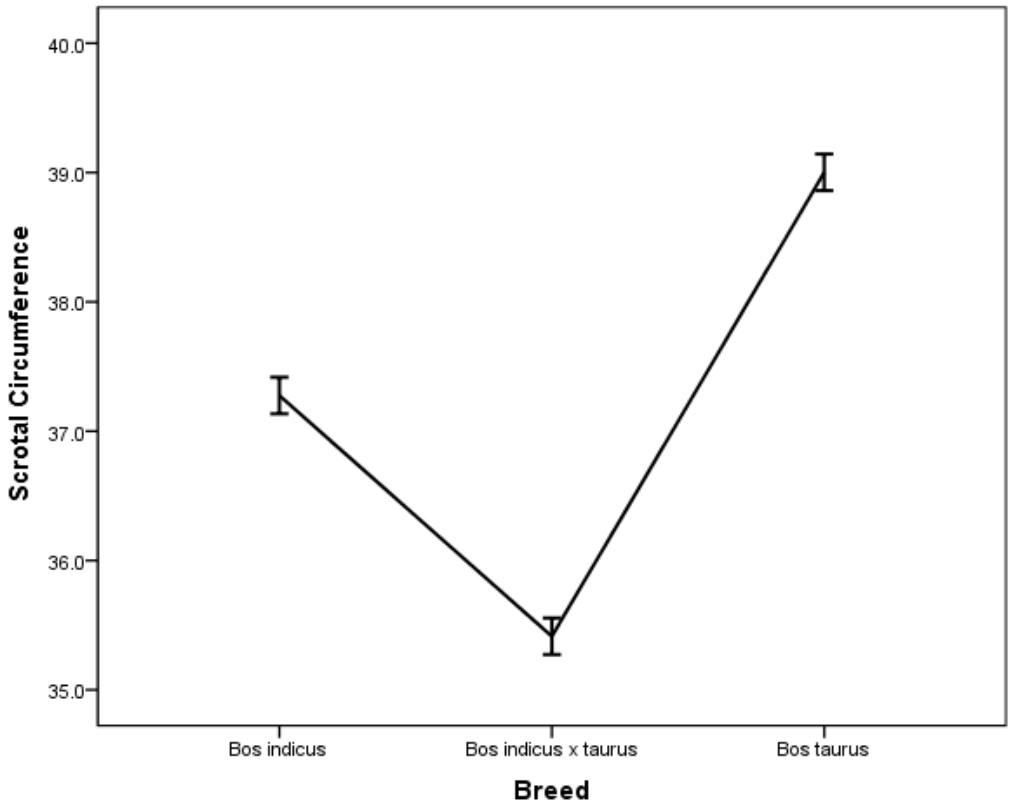

Figure 4: Relationship between Breed and Scrotal circumference

September to December. Ndlovu and Muchenje (2009) stated that BCS is the best indicator of cattle nutritional status by practitioners. Therefore, the low BCS values obtained in October could be due to poor pasture available in the month of October in Zambia leading to poor nutrition available for the proper nourishment of the animals during this period (Sitali et al., 2016).

The correlation between SC and month observed in this study is in agreement with earlier studies where a change in SC of various bulls were reported (Chacon et al. 1999; Guerra et al. 2013). However, our findings oppose the results of Garcia-Paloma, (2015) who found no relationship between season and SC in the beef bulls that were studied. The current study revealed that higher SC values were obtained during the period between July to August which agrees with Chacon et al. (1999) who found higher SC values between March and August. The higher SC values obtained during this period could be due to favourable temperatures in the period leading to an increased feed intake or a higher consumption of pastures by the animals and a higher digestibility of pastures during this period; this in turn leads to an improved BCS which directly affects SC (Chacon et al., 2002). However, our lower SC values are in contrast with those of Chacon et al. (1999), who found lower SC values in the period September to February while our study recorded lower SC values between May and June.

Chacon et al. (2002) found that every unit increase in BCS was followed by an increase of 0.7cm in SC. These results are in line with the findings of our study where BCS was found to have a positive relationship with SC. A low SC could be due to testicular asymmetry, hypoplasia, fibrosis and atrophy (Chacon et al., 1999). Furthermore, Akpa et al. (2012), found a positive relationship between body measurement and testicular measurements in the Yankasa ram from the tropical regions of Nigeria.

The Findings of our study indicated that the *Bos taurus* bulls had a larger SC compared to the *Bos indicus* and *Bos indicus x taurus* bulls. Brito et al. (2004) stated that the *Bos indicus* bulls have a lower SC compared with the *Bos taurus* bulls of the same age. Chacon et al. (1999) reported a lower SC in Nellore bulls compared with Guzerat bulls at 18 months of age. They further stated that poor selection among the *Bos indicus* bulls could be the cause of the inherited low SC of these bulls in the tropics. The delayed sexual developement of the *Bos indicus* compared to the *Bos taurus* bulls could be another factor (Randel, 2005;Chenoweth et al., 1996). These findings confirm a slow growth rate pattern in the *Bos indicus* bulls compared with *Bos taurus* bulls and also support the effect of interaction between breed and environment on SC.

Breed was positively correlated with BCS. The findings of our study are in agreement with those of Ndlovu & Muchenje (2009), who found breed changes in BCS. They found a peak BCS in March for the *Bonsmara* and *Nguni* bulls while BCS for the *Angus* declined from September until January. Our study showed that the *Bos indicus x taurus* bulls had lower BCS compared to the *Bos indicus* and the *Bos taurus* during the study period. The difference in the patterns of BCS could, possibly, reflect the subjective nature of body condition scoring, especially when animals of different conformation are being compared (Ndlovu and Muchenje, 2009).

CONCLUSION

The data obtained from the study provide evidence that the relationship of age, month, BCS, SC and breed of bulls on Zambian commercial farms is similar to other cattle breeds. Furthermore, judging from the relationship between the variables, it can be concluded that optimal ferility of the bulls kept on Zambian commercial farms and subsequent conception rates in heifers/cows depend on the interaction of these variables.

Conflict of interest

The authors declare no conflict of interest.

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