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Short Communication

Relationship between Testicular Traits, Body Measurements and Body Weight in Boer Goat Bucks

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ABSTRACT

The study was conducted to evaluate the relationships between testicular traits, body measurements and body weight. A total of twenty-five (25) Boer goat males aged between one and two years were used in the study. Testicular length (TL), scrotal circumference (SC), body weight (BW), body length (BL), heart girth (HG), rump height (RH), withers height (WH) and sternum height (SH) were measured. Pearson's correlation and simple linear regression were used for data analysis. Phenotypic correlation outcomes indicated that SC had a positive statistically significant (P<0.05) correlation with BW (r = 0.425) and non-significant correlation with BL (r = 0.108), HG (r = 0.082), RH (r = 0.038), WH (r = 0.097) and SH (r = 0.280), while TL had non-significant correlation with BW (r = 0.009), BL (r = -0.351), HG (r = -0.147), RH (r = -0.108), WH (r = -0.086) and SH (r = 0.052). Regression analysis model showed that SC had the highest coefficient of determination R^2 (0.178) as compared with other testicular traits and body measurements. In conclusion, the relationship results suggest that by improving scrotal circumference might result in improving the body weight of Boer goat's bucks. Simple linear regression results suggest that scrotal circumference is great trait to predict body weight of Boer goat's bucks. The findings of the present study might be employed by the resource limited Boer goat's farmers to select their bucks for breeding and also to improve their body weight.

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Key words
Testicular length, Scrotal circumference, Body length, Heart girth, Regression.

Goats are found to be the easiest achievable source of income which is there to meet emergency social and financial needs of farmers (Boogaard and Moyo, 2015). Boer goats are greatest goat breeds for meat yield and has good body structure, rapid growth rate and good carcass grades (Yousuf *et al*., 2020; Mathapo and Tyasi, 2021). Body weight (BW) can suggest clear ideas about performance of the upcoming kids in the herd (Patni *et al*., 2015). Body weights play a vital role to farmers in decision making such as selecting animals for breeding, setting price for live animals and another animal management (Tariq *et al*., 2012; Tsegaye *et al*., 2013). Testicular traits and BW have been spotted as a vital measure for determining breeding ability in animals (Kerketta *et al*., 2015). Flock production and its sexual capability is more determined by male's fertility as compared to females (Shende *et al*., 2019). Therefore, selection of bucks with high fertility is very crucial in goat production. However communal farmers find it difficult to select their bucks due to lack of information related to fertility tests and the expensiveness of getting such data from each buck in a herd (Waheed *et al*., 2011). Testicular traits have been used as a tool for selection of breeding bucks in goat's production (Agga *et al*., 2011; Shoyombo *et al*., 2012; Akpa *et al*., 2013). Raji *et al*. (2008) reported an association between testicular traits and live BW in male animals. According to our understanding, there are very limited facts provided on the association between testicular traits, body measurements and BW in Boer goat bucks. This study was intended to establish the association between BW and testicular traits (testicle length and scrotal circumference) of Boer goat bucks with the aid of Pearson correlation and to establish a model to predict BW from testicular traits using simple linear regression. This study will aid farmers who can not afford to know the association between testicular traits, body measurements and BW, and also to employ testicular traits to select fertile bucks for breeding.

Materials and methods

Pieter Smith Boer goat farm located in Alldays, Limpopo province, South Africa was used as study location

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(22.6825°S, 29.1027°E). Alldays is a small town in Limpopo province that serves a large area of private game and hunting farms. The region temperature is strongly associated with seasonal conditions, which is warm wet season from December to February with temperature of 16 to 40°C and cool dry season from May to August with temperature of 12 to 22°C (Dzivhani, 1998). A total of 25 Boer goat bucks aged between one and two years old were used. Goats were managed extensively where they were released in the morning for grazing and recall them back to the kraal late in the afternoon, where they provide them with water *at libtum* water. The area is described as bushveld which consist of eragrostis lehmanniana and the acacia tortilis (MacVicar *et al*., 1991).

Tailor's measuring tape was used to measure body measurements according to Lukuyu *et al*. (2016) and testicular traits in centimeters (cm) according to Akpa *et al*. (2012), while BW was measured with a weighing scale calibrated in kilograms. Briefly, testicular length (TL) was measured as a distance from its point of attachment along the caudal surface to the tip of the scrotum, scrotal circumference (SC) measured as the largest diameter of testes firmly into the scrotum, body length (BL) distance from the occipital protuberance to the base of the tail, heart girth (HG) circumference of chest, rump height (RH) measured from the surface ground to the rump, withers height (WH) measured from the surface ground of fore front leg to the withers and sternum height (SH) measured from the lower tip of the sternum to the ground as the animal standing. The measurements were taken between 12pm and 1am midday before releasing the animals. Only one person was assigned to take the measurements in the study to avoid individual variation on taking measurements.

Statistical Package for Social Science version 23 (IBM SPSS, 2015) was employed for analyses of data. Descriptive statistics was computed for summary of measured traits. Pearson's correlation was employed to determine the association between testicular traits, body measurements and BW. Simple linear regression was employed to develop a model to predict BW from testicular traits. Below is linear regression model which was performed:

$$Y = z + s1b1 + s2b2 + s3b3$$

Where, Y is dependent variable (BW), z is regression intercept, s1 – s3 are coefficient of regression, and b1 – b3 are independent variables (SC and TL).

Results

The mean (±SEM) for BW, BL, HG, RH, SH, WH, TL and SC were found to be 46.12±1.51, 80.84±1.95, 88.20±1.60, 69.04±0.71, 45.56±0.69, 70.68±0.77, 20.32±0.48 and 31.40±0.53 cm, respectively.

Table I shows the association between testicular traits, body measurements and BW of Boer goat bucks. The findings of the study indicated that SC showed a positive significant statistical correlation with BW ($r = 0.422^{*}$) and non-significant correlation with BL (0.108^{ns}), HG (0.082^{ns}), RH (0.038^{ns}), WH (0.097^{ns}) and SH (0.280^{ns}). TL was non-significant correlated with BW ($r = 0.009^{ns}$), BL ($r = -0.351^{ns}$), HG ($r = -0.147^{ns}$), RH ($r = -0.108^{ns}$), WH ($r = -0.086^{ns}$) and SH ($r = 0.052^{ns}$). BW was non-significant correlated with BL ($r = -0.093^{ns}$), HG ($r = 0.130^{ns}$) and WH ($r = -0.173^{ns}$), statistical positive significant with RH ($r = 0.456^{*}$) and SH ($r = 0.387^{*}$). BL was highly statistically correlated with HG ($r = 0.669^{**}$), WH ($r = 0.620^{**}$) and negatively correlated with TL ($r = -0.351^{*}$), and non-significant with RH ($r = 0.120^{ns}$), SH ($r = -0.241^{ns}$). HG was statistically correlated with WH ($r = 0.363^{*}$), negatively correlated with SH ($r = -0.355^{*}$) and non-significant with rump height ($r = 0.044^{ns}$). Wither's height was non-significant with SH ($r = -0.095^{ns}$).

Models to estimate BW from SC and TL are shown in Table II. First mode (Y= 8.55 + 1.197SC) with 17.8% difference in BW was explained SC which was significant. Second model (Y= 45.54+ 0.029TL) with 0.00% difference in body was explained by TL.

Table I.- Phenotypic correlation coefficient between testicular traits, body measurements and body weight.

Traits	BW	BL	HG	RH	WH	SH	SC	TL
BW								
BL	-0.093^{ns}							
HG	0.130^{ns}	0.669^{**}						
RH	0.456^{*}	0.120^{ns}	0.044^{ns}					
WH	-0.173^{ns}	0.620^{**}	0.363^{*}	0.222^{ns}				
SH	0.387^{*}	-0.241^{ns}	-0.355^{*}	-0.279^{ns}	-0.095^{ns}			
SC	0.422^{*}	0.108^{ns}	0.082^{ns}	0.038^{ns}	0.097^{ns}	0.280^{ns}		
TL	0.009^{ns}	-0.351^{*}	-0.147^{ns}	-0.108^{ns}	-0.086^{ns}	0.052^{ns}	0.223^{ns}	

BW, body weight; BL, body length; HG, heart girth; RH, rump height; SH, sternum height; SC, scrotal circumference; TL, testicular length; ns, non-significant; **, $P<0.01$; *, $P<0.05$.

Table II.- Prediction models of body weight from testicular traits.

Traits	Model	R^2
Scrotal circumference	Y= 8.55 + 1.197SC,	17.8
Testicular length	Y= 45.54+ 0.029TL	0.00

Y, body weight; SC, scrotal circumference; TL, testicular length; *P < 0.05; R^2, Coefficient of determination.

Discussion

Testicular traits can be employed to determine the fertility of males in animal production (Shende *et al*., 2019). Our results showed that SC had a positive statistically significant correlation with BW while TL had a no significant correlation with BW. SC and TL were found to be non-significant with all body measurements included in the study. The findings of the present study agree with results of Waheed *et al*. (2011), though disagree with the results of Gemeda and Workalemahu (2017) who strong positive and significantly correlation of TL with BW in three indigenous goat bucks of Ethiopia. This might be due to different goat breeds and the environmental conditions. Ahmed and Kawmani (2019) findings were similar with the current findings where they reported a positive significant correlation between BW and SC in sheep. The results of the current study were not similar to results of Varghese *et al*. (2019) since they found both SC and TL having strong statistical positive correlation with BW in Deoni bulls. This might be due to different species, as they used cattle and current study used goats. Abba *et al*. (2021) reported a statistical weak correlation between SC and BW in Sahel bucks that were in contrast with the findings of the current study. This might be due to different sample size of goats used in both studies and different goats' breed. The findings of present study suggest that SC may be employed as a selection criterion of bucks for breeding. According to Lorentz *et al*. (2011) correlation coefficient only indicates the relationship between traits without finding the genesis effect relation between the traits. Therefore, the use of simple linear regression is to establish a model for estimation of BW from testicular traits. Findings of the present study showed high coefficient of determination in SC as compared to TL. Therefore, SC had high contribution towards BW of Boer goat's bucks and can be employed to estimate their BW. The results of present study agree with those of Mabu *et al*. (2020) who reported SC as the best predictor of BW in Yankas rams. Results of the current study where in contrast with results of Raji *et al*. (2008) where scrotal length was found to be describing more variation in BW than scrotal length in Born white and Red Sokoto indigenous goats breeds of Nigeria. This might be due to age of goats, different breed and the environmental factors. The variation explained by SC on BW in current study was less than the one explained by Keith *et al*. (2009) in pubertal Boer goats.

Conclusion

In conclusion, findings of the present study showed an association between testicular traits and BW in Boer goat bucks. However, the SC was statistically positive and significant correlated with BW of Boer goat bucks. Simple linear regression results suggest that SC had a positive statistically significant effect on BW of Boer goat bucks. The findings of the present study revealed that SC is a great determiner of bucks breeding ability which can be employed by breeders and communal farmers who cannot afford to select their bucks for breeding. More studies need to be conducted on developing a model to predict BW from testicular traits in Boer goat bucks and to investigate the association between BW and testicular traits using more sample size or even different goat breed.

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Statement of conflict of interests

The authors declare that they have no conflict of interest.

References

Abba, A., Mustapha, A.R., Mustapha, B.U., Iliyasu, D., Peter, I.D., Asuku, S.O., Stephen, J. and Waziri, M.A., 2021. *Sahel J. Vet. Sci.*, **18**: 1-5.

Agga, G.E., Udala, U., Regassa, F. and Wudie, A., 2011. *Small Rumin. Res.*, **95**: 133–138. https://doi.org/10.1016/j.smallrumres.2010.09.011

Ahmed, A. and Kawmani, A.L., 2019. *J. appl. Sci.,* **19**: 605-611. https://doi.org/10.3923/jas.2019.605.611

Akpa, G.N., Suleiman, I.O. and Alphonsus, C., 2012. *Continental J. Anim. Vet. Res.*, **4**: 7-10. https://doi.org/10.5897/SRE11.458

Akpa, G.N., Ambali, A.L. and Suleiman, I.O., 2013. *Int. J. appl. Res. Technol.*, **2**: 114-125.

Boogaard, B.K. and Moyo, S., 2015. *The multi-functionality of goats in rural Mozambique: Contributions to food security and household risk mitigation*. ILRI Research Report 37. ILRI, Nairobi, Kenya.

Dzivhani, A.M., 1998. *Temperature and rainfall variability over the Northern Region of the*

Northern Province for the past 35 years. BA. Hons. thesis, University of Venda.

Gemeda, A.E. and Workalemahu, K., 2017. *J. Vet. Med.*, **2017**: 5276106. https://doi.org/10.1155/2017/5276106

Keith, L., Okere, C., Solaiman, S. and Tiller, O., 2009. *Res. J. Anim. Sci*., **3**: 26-31.

Kerketta, S., Singh, M., Patel, B.H.M., Dutt, T., Upadhyay, D., Bharti, P.K., Sahu, S. and Kamal, R., 2015. *Small Rumin. Res.*, **130**: 193-196. https://doi.org/10.1016/j.smallrumres.2015.07.006

Lorentz, L.H., Genova, D.E., Gaya, L., Lunedo, R., Ferrazj, B.S. and Rezende, F.M., 2011. *Sci. Agric. Piracicaba Brazil*, **68**: 320-325. https://doi.org/10.1590/S0103-90162011000300008

Lukuyu, M.N., Gibson, J.P., Savage, D.B., Duncan, A.J., Mujibi, F.D.N. and Okeyo, A.M., 2016. *SpringerPlus*, **5**: 63. https://doi.org/10.1186/s40064-016-1698-3

Mabu, M.I., Mabu, J.M., Anka, B.A. and Saheed, Y., 2020. *Asian J. Biotechnol. Genet. Engin.*, **3**: 39-46.

Macvicar, C.N., Bennie, A.T.P. and de Villiers, J.M., 1991. So*il classification: A taxonomic system for South Africa*. Department of Agricultural Development, Pretoria.

Mathapo, M.C. and Tyasi, T.L., 2021. Prediction of body weight of yearling boer goats from Morphometri c Traits using classificatio n and regression tree. *Am. J. Anim. Vet. Sci.,* **16**: 130-135.

Patni, M., Singh, S.K., Singh, D.V., Palod, J., Kumar, A., Singh, K.M. and Sathapathy, S., 2015. *Indian J. Anim. Res*., **50**: 105-111.

Raji, A.O., Igwebuike, J.U. and Aliyu, J., 2008. *ARPN J. Agric. biol. Sci.*, **3**: 4.

Shende, V.H., Sontakke, S.H., Potdar, V.V., Tejsjree, V., Shirsath, H. and Khadse, J.R., 2019. *Int. J. Curr. Microbiol. appl. Sci.*, **8**: 11. https://doi.org/10.20546/ijcmas.2019.811.264

Shoyombo, A., Fasanya, O., Bunjah, U. and Yakubu, H., 2012. *World J. Life Sci. med. Res.*, **2**: 114.

SPSS, 2015. *IBM SPSS statistics for windows*, Version 23.0. IBM Corp., Armonk, NY.

Tariq, M.M., Eyduran, E., Bajwa, M.A., Waheed, A., Iqbal, F. and Javed, Y., 2012. *Int. J. Agric. Biol*., **14**: 590–594.

Tsegaye, D., Belay, B. and Aynalem-Haile, A., 2013. *Glob. Vet.,* **11**: 649-656.

Varghese, M.R., Mukund, A., Kataktalware, S., Jeyakumar, D.N., Das, K., Ramesha, P. and Pratik, R.W., 2019. *Indian J. Anim. Res*., **53**: 1624-1628.

Waheed, A., Khan, M.S., Ahmed, A.N., Tariq, M.M., Rauf, M. and Eyduran, E., 2011. *J. Inst. Sci. Tech*., **1**: 59-62.

Yousuf, F.E., Apu, A.S., Talukder, K.U., Ali, M.D.Y. and Husain, S.S., 2020. *J. Bangladesh Agric. Univ.*, **18**: 428-434.