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Relationship between Body Weight and Linear Body Measurements in Boer Goats

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Abstract

Fifty-five Boer goats from a private farm located at Kg Pulau Meranti, Mukim Dengkil, Puchong, Selangor was sampled to examine the relationship between body weight and linear body measurements (body length, height at withers and heart girth). The goats were of four age groups: Group 1 (4-12 mo), Group 2 (13-18 mo), Group 3 (19-24 mo) and Group 4 (25-36 mo). Body weight and linear body measurements (body length, height at withers and heart girth) were taken during a 7-d period in December 2010. The body weight and linear body measurements were not significantly ($p>0.05$) different between male and female goats but were significantly($p<0.05$) different among age groups. Male goats were heavier in weight, longer in body length, taller in height at withers and larger in heart girth compared to the female goats. Pearson's coefficient of correlation showed positive, high and significant correlation between body weight and linear body measurements and also among the body measurements.A simple linear regression equation with a high coefficient of determination ($R = 0.948$) using heart girth to predict body weight of Boer goats was also derived.

Keywords: Boer goats, body weight, body length, height at withers, heart girth

Introduction

Goat is a multifunctional animal and plays a significant role in the economy and nutrition of small farmers in Malaysia. Boer goat farming in Malaysia recorded an annual growth rate of more than 6% between 2006 to 2010. With the support from the Ministry of Agriculture and Agro-based Industry, Malaysia and its associated financial and development agencies, the future seems bright for Boer goat farming. The National Goat Production Programme targets to have 2 million goats in Malaysia by 2015 (Aziz, 2009) and by 2020 the country is envisaged to have 3.2

million goats for breeding. These goats will be the production units to supply 68% of the national requirement for goat meat by 2020. Boer goat is considered to be one of the most desirable goat breeds for meat production. It has gained worldwide recognition for its excellent body conformation, fast growing rate and good carcass quality. Its popularity as a meat goat breed soared during the last decade due to its availability in Australia, New Zealand and later in North America and other parts of the world. It has been demonstrated that Boer goats can improve productive performance of many indigenous breeds through crossbreeding (Lu, 2002). One study conducted in Pakistan showed that the relationship between linear body measurements, such as body length, heart girth and height at withers, and body weight is found to be positive in goats and could be used as selection criteria for the goats (Khan *et al*., 2006). However, information on body weight and linear body measurements of goats in Malaysia is scarce. This current study is performed to obtain more information on the characteristics of Boer goats in Malaysia. The information on the relationship between body weight and linear body measurements of Boer goats is important for the estimation of size and shape of goats suitable for breeding and slaughter. The objectives of this study were to determine the relationship between the body weight and linear body measurements of Boer goats and to predict body weight from linear body measurements in goats.

Materials and Methods

Animals

Fifty-five healthy Boer goats were selected at random from a private farm (De Kebun Enterprise) located at Kg Pulau Meranti, Mukim Dengkil, Puchong, Selangor. The animals were divided into four age groups: Group 1 (4-12 mo), Group 2 (13-18 mo), Group 3 (19-24 mo) and Group 4 (25 -36 mo). The age of the animals was obtained by referring to the birth records when available or estimated by the number of permanent incisors present. The farm practiced intensive rearing system where the goats were managed indoor with feeds provided in feeding troughs twice a day. The goats were not allowed to graze and feeds were brought to the goats. The goats were fed with cut native grass (*Paspalum conjugatum, Axonopuscompressus)*, commercial goat pellet (14% crude protein) and soya bean waste from the processing of tofu and soya drinks.

Body Measurements

Body weight and linear body measurements were taken to determine the body conformation of the goats. Body weight (BWt) was determined using a hanging weighing scale (100 kg), early in the morning before feeding. The body weight was measured in kilograms to one decimal point. The goats were fasted overnight before weighing.

Height at witers (HAW) was measured from the bottom of the front foot (phalanges) to the highest point of withers between the shoulders by using a one-metre ruler. The measurement was in centimetres, to the nearest whole number.

Heart girth (HG) or circumference of chest was measured as the circumference of the body immediately behind the shoulder blades in a vertical plane, perpendicular to the long axis of the body and measured by using a girth tape. The measurement was in centimetres, to the nearest whole number.

Body length (BL) was measured as the distance from the point of shoulder (dorsal spine of scapular) to the posterior edge of the pin bones (tuber Ischia) using a measuring tape. The measurement was in centimetres, to the nearest whole number.

Statistical Analysis

Data collected were classified on the basis of sex and age. Statistical analysis for body weight and linear body measurements was carried out with SPSS Statistical Software Program version 16.0 (2008). The data were examined for normality in distribution. The relationship between body weight and linear body measurements was measured using Pearson's coefficient of correlation. ANOVA for 2 factors (Sex and Age Groups) was done for body weight and linear body measurements and comparison of means between groups was carried out using Tukey test upon significant F value for the factors of the ANOVA. Simple linear regression analysis was done to predict the body weight of Boer goats using linear body measurements as independent variables (IV).

Results and Discussion

From the Pearson's coefficients of correlation, there were positive, high and significant ($p<0.01$) correlations between BWt and BL, HAW and HG with correlation coefficients (r) of 0.93, 0.91 and 0.97, respectively, and also between the body measurements (Table 1). Similarly Mukherjee *et al*., (1981) and Singh *et al*., (2004) reported a high significant correlation between body weight with heart girth in brown Bengal does and grey Bengal goats.

Means for BWt and linear body measurements were not significantly different between male and female goats but were significantly different between age groups. As an animal got older, body weight and linear body measurements would also increase (Table 2). Male goats were noted to be heavier in weight, longer in body length, taller in height at withers and larger in heart girth compared to the female goats as was also reported by Khan *et al*., (2006). The results obtained regarding the live weight of Boer goats were lower than those reported previously by Lu and Potcoiba (2002). Factors affecting these measurements are known to be sex, nutrition, type of birth, and environment (Hassan and Ciroma, 1990).

Table 1. Correlation coefficients among body weight and body measurements in Boer goats

	Body length	Height at withers	Heart girth
Body weight	0.93**	0.91**	0.97**
Body length		0.93**	0.94**
Height at withers			0.95**

** Correlation significant at p = 0.01 level.

Table 2. Means (±SE) for body weight and linear body measurements for sex and age groups of Boer goats

		Body weight[1] (kg)	Body length[1] (cm)	Height at withers[1] (cm)	Heart girth[1] (cm)
Sex	Female	37.31^{a}±0.72	56.26^{a}±0.50	62.79^{a}±0.59	76.85^{a}±0.62
	Male	40.06^{a}±1.18	59.71^{a}±0.82	64.15^{a}±0.96	78.80^{a}±1.01
Age groups	4 -12 months	22.56^{a}±1.13	47.44^{a}±0.79	53.13^{a}±0.93	62.99^{a}±0.97
	13 -18 months	37.15^{b}±1.27	53.57^{b}±0.90	60.16^{b}±1.05	75.96^{b}±1.10
	19 - 24 months	42.60^{c}±1.27	60.18^{c}±0.90	64.30^{b}±1.05	80.77^{c}±1.10
	25 - 36 months	52.44^{d}±1.73	70.75^{d}±1.21	76.30^{c}±1.42	91.58^{d}±1.49

[1]Means with different superscripts between rows within each category of sex and age groups are significantly different at p=0.05.

Table 3. Regression coefficients (b) and coefficients of determination (R^2) for the different models to predict body weight in Boer goats

Regression Model[1]		Coefficients*				
		b_0	b_1	b_2	b_3	R^2
1-IV model	HG	-43.358	1.054			
	BL	-32.358	1.234			
	HAW	-40.286	1.245			0.835
2-IV model	HAW + BL	-37.746	0.796	0.483		
	HG + BL	-42.988	0.932	0.159		
	HG + HAW	-42.561	1.185	- 0.175		0.950

cont'd Table 3

3-IV model	HG + HAW + BL	-41.566	1.070	-0.269	0.243	0.953

[1] Regression models: 1-IV model includes 1 independent variable, 2-IV model includes 2 independent variables and 3-IV model includes 3 independent variables
[*] Significant at p=0.05

Simple linear regression models were developed to include one or more independent variable as the predictor variable to predict BWt. The 1-IV models included one independent variable of BL, HAW or HG and the dependent variable, BW. The 2-IV models included two independent variables and the 3-IV model included all three independent variables (Table 3). Among the 1-IV models, HG as a predictor variable of body weight had the highest R^2 value (0.948). Using 2 independent variables in predicting body weight, the inclusion of HG and BL or HG and HAW resulted in equal R^2 values (0.948 - 0.950), similar to the model with HG as the predictor variable. The highest R^2 value (0.953) was obtained by including all three independent variables of HG, BL and HAW in the model. In terms of R^2 value, the best regression models for one independent variable of HG (0.948), the 2 independent variables of HG and HAW (0.950) and the 3 independent variables of HG, BL and HAW (0.953) had almost similar coefficients of determination. This meant that using HG alone was sufficient to predict body weight as indicated by the high R^2 value of its regression model. The predictive value of the linear body measurement of animals had been used to determine body weight by Benyi (1997) in goats and Dale and Bunnell (1984) and Attah *et al*. (2004) in sheep and the chest girth was found to be a useful tool in this regard.

Conclusion

There is a positive and significant relationship between the body weight and linear body measurements (body length, height at withers and heart girth) in Boer goatsand the most practical way to estimate the live weight of goats is by measuring the heart girth of the goats, especially where equipment to definitively quantify the weight of animals are not available and inaccessible. Since heart girth has a high correlation with the body weight, this may be used as a selection criterion to improve body weight indirectly. Earlier reports also indicated that selection based on the body measurements could improve meat production. However, further research is needed to investigate the relationship between body weight with linear body measurements in larger samples of similar and other breeds of goats in other parts of the country.

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