GENETIC RELATIONSHIP AMONG GROWTH BIOMETRICS OF INDIGENOUS RED SOKOTO AND EXOTIC BOER GOATS IN SEMI ARID, KANO

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Abstract

The study aims to determine relationship among growth biometrics of Red Sokoto and exotic Boer breeds. Live body weights (kg) and morphometric traits (cm) of the two breeds were measured on monthly basis for a period of one year at the goat herd of the Centre for Dryland Agriculture, Bayero University, Kano. Data analyses were executed using JMP pro 14.0 Statistical Analysis System (SAS). The result revealed positive and highly significant ($p<0.01$) correlations between body weight and most of the morphometric variables for the Boer breed. It was observed that strong positive relationship exists between body weight and wither height, hip height, body length, chest depth and heart girth ($r = 0.73$; 0.72; 0.71; 0.75 and 0.86), respectively. Heart girth was high and positively correlated to wither height, hip height, right horn length, left horn length, body length and chest depth ($r=0.75$; 0.74; 0.78; 0.77; 0.71 and 0.79), respectively. In comparison to the Boer goats, Red Sokoto goats recorded from small to positive significant ($p<0.05$) correlation coefficients between body weight and other measured traits. However, highest correlation coefficients were observed in hip height with wither height ($r = 0.79$) and left horn length with right horn length ($r = 0.95$). The positive correlations in these traits showed they are influenced by the same genes. Therefore, selecting for one trait will likely lead to improvement in the other correlated trait.

Keywords: Biometrics, Boer, Correlation, Growth, Red Sokoto.

Description of Problem

Goats are essential livestock in Africa and Asia, providing meat, milk, and wool, and supporting rural livelihoods due to their high utilization and economic value (1)(2). The Red Sokoto goat, widely found in Northern Nigeria, makes up about half of the nation's goat population (3). It is small, slender, deep red in color, and both males and females have horns and short, horizontal ears (4). The improved Boer goat (*Capra aegagrus hircus*), developed in semi-arid South Africa for better weight gain, is a top meat-producing breed after selection (5)(6). It is typically white with a brown or red head, with mature bucks weighing 90–130 kg and does 80–100 kg, making it desirable goat breeds for meat production (7).

Body weight of an animal is an important parameter which affects animal production in various ways. Knowledge on weight assessment remains the backbone on which animal production is hinged. It is related to breeding (selection), feeding, marketing and health care (8). Biometric traits had been used to predict body weight by several authors in many breeds of goats in Nigeria (9). Correlation is one of the most common and most useful statistical tools that describe the degree of relationship between two variables. Therefore, the study aims to determine the relationship among biometric traits and body weight that could assist breeders make selection for improve breeding practices.

Materials and Methods

Experimental Location

The study was conducted in the pure breed herd of Red Sokoto and Boer goats of the Centre for Dryland Agriculture Training and Research Farm, Bayero University, Kano. The Research Farm lies within longitude $11^{0}58.771´$ East and latitude $8^{0}25.851´$ North at an altitude of 472 m above sea level (GPS Coordinates). The average monthly minimum and maximum temperatures of the study location were 9.2^{o}C and 34.5^{o}C respectively. The total annual rainfall of the study area is 719.4 mm (Meteorological Station; Geography Department BUK, 2019). Ten pure

South African Boer goats were purchased from Majestic Dairy Farm Birnin Kudu, Jigawa State, which comprised of eight does and two bucks. Twenty pure Red Sokoto (Maradi) goats which comprised of seventeen does and three bucks were purchased from the Secondary Center of Caprine Breeding, Maradi, Niger Republic located 1.5 km east of the city of Maradi in Niger Republic.

Experimental Animals and Management

The study used Red Sokoto and Boer goats aged 9–12 months, with average initial weights of 16.90 kg and 18.43 kg respectively. Ages were confirmed by records and dentition, and only healthy, non-pregnant animals were selected. A two-week quarantine and adaptation period was observed. Pens were cleaned, disinfected, and maintained regularly, with feeding and watering troughs provided and water given *ad libitum*. The goats were kept in confined pens and fed twice daily (5% of body weight). The concentrate, containing 19.14% crude protein, was given in the morning and evening and included ingredients like cottonseed cake, wheat offal, rice mill waste, poultry litter, cowpea husk, *Piliostigma reticulatum* ("Kalgo pods"), groundnut hay, and salt. The feed was a 60:40 mix of concentrate to roughage, with groundnut hay provided *ad libitum*. Animals were treated for internal parasites with Albendazole (7.5 mg/kg) and given long-acting Oxytetracycline (10 mg/kg). External parasites were controlled using Pour-on® with Cypermethrin. Sick animals were isolated and treated.

Data Collection

i) Live body weights (kg) of Red Sokoto and Boer were measured after every four weeks up to one year. A sensitive weighing MRY bathroom scale with 120 kg capacity Camry® was used. It was obtained by taking the weight of the researcher, then weight of the researcher and the animal, and later the researcher's weight was subtracted from the total, which gave the actual body weight of the animal (10).

ii) Morphometric Characteristics

Sets of morphometric characteristics (heart girth, body length, lateral length, wither height, hip height, hip width, hip length and shoulder width) were taken as described by (11) (12) (13) and (14). Morphometric traits of the experimental animals were measured for twelve months and were properly restrained while taking the measurements for accuracy. Pregnant animals were avoided during the measurement as their physiological state had changed the form and shape of their physique. The traits were measured using flexible measuring tape (tailor's tape) graduated in centimetres (cm); Heart girth (HG), body length (BL), lateral Length (LL), wither height (WH), hip height (HH), hip width (HW), hip length (HL), shoulder width (SW), chest Depth (CD) head circumference (HC), neck length (NL), face Length (FL), face width (FW), ear length (EL; Right and Left), horn length (HL; Right and left), cannon Length (CL) and tail length (TL)

Data Analysis

Data collected were screened for missing values and outliers prior to analysis. All data analyses were executed using Excel, XLSTAT and JMP pro 14.0 Statistical Analysis System (15).

Results and Discussion

The relationship of body weight with morphometric traits for Red Sokoto and Boer goats is presented in Tables 1 and 2. Positive and highly significant ($p<0.01$) correlations were observed between body weight and most of the morphometric variables for the Boer breed. It was observed that strong relationship exists between body weight and wither height ($r = 0.73$), hip height ($r = 0.72$), body length ($r = 0.71$), chest depth ($r = 0.75$) and heart girth ($r = 0.86$). The highest correlation coefficients were observed between the right horn length with left horn length ($r = 0.95$) Heart girth was high and positively correlated to wither height, hip height, right horn length, left horn length, body length and chest depth ($r=0.75$, $r=0.74$, $r=0.78$, $r=0.77$, $r=0.71$ and $r=0.79$), respectively. In contrast to the Boer goats, Red Sokoto goats recorded small, moderate and positive significant ($p<0.05$) correlation coefficients between body weight and other measured traits. There exists non-significant ($p>0.05$) relationship among other morphometric traits. However, highest correlation coefficients were observed in hip height with wither height ($r = 0.79$) and left horn length with right horn length ($r = 0.95$). Estimating the live body weight of goat is important for good management and body conformation measurements are important for introducing community based indigenous goat

breed improvement through selective breeding system. Therefore, live body weight can be estimated without using scale in which live body weight is regressed on selected body measurements. Heart girth, body length and height at wither are the most important linear body traits for estimation of live body weight. Correlation is one of the most common and most useful statistical tools that describe the degree of relationship between two variables. Body measurements can reliably estimate live weight in goats due to their strong positive correlation, especially when scales are not available. The strong relationship between body weight with wither height, hip height, body length, chest depth and heart girth is consistent with the findings of (16) and (17). This result is amenable to many findings as reported by (18). However, the decline in the correlation coefficients in the Red Sokoto might be lack of adaptability to the new environment which leads to stunted growth and development with less flesh accumulation in comparison to the improved Boer breed (19). It was reported that the muscle and bone around the heart region was responsible for the relatively higher and positive relationship between body weight and heart girth when compared to other linear traits (20). Also, high positive relationship among traits suggests that they are under the same gene action and can also be predicted from one another singly or in combinations (21). Similarly, positive correlation among traits could be as a result of pleiotrophic effects of genes and linkage effects which operate on these traits (22). Therefore, any attempt to perform phenotypic selection for one trait will consequently result in improvement of the other (23).

Conclusion

In conclusion, heart girth is the best predictor for estimating live body weight in the goats. The positive correlations suggest that these traits are influenced by the same genes (pleiotropy and genetic linkage). Therefore, selecting for one trait will likely lead to improvement in the other correlated trait.

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Table 1: Pearson Correlation between Body Weight and Morphometric Traits of Red Sokoto goat

	BW	WH	HH	FL	FW	NL	REL	LEL	HC	RHL	LHL	CL	LL	BL	CD	SW	HG	HW	HL	TL
BW		0.13	0.08	0.38**	0.25*	0.14	0.03	0.05	0.03	0.16	0.19	0.21	-0.04	0.04	0.23*	0.23*	0.27*	0.09	0.10	0.07
WH			0.79**	0.30**	0.32**	0.45**	0.21*	0.24*	0.13	0.22*	0.25*	0.13	-0.14	0.19	0.30**	0.33**	0.25**	-0.24*	0.18	-0.06
HH				0.22*	0.17	0.50**	0.20	0.13	0.11	0.09	0.11	0.05	-0.11	0.19	0.34**	0.34**	0.22*	-0.25*	0.23*	-0.13
FL					0.38**	0.21*	0.01	0.09	0.33**	0.45**	0.44**	0.10	0.01	0.11	0.40**	0.25*	0.51**	-0.14	0.38**	0.12
FW						0.20	-0.11	0.05	0.15	0.32**	0.35**	0.05	-0.11	0.18	0.30**	-0.06	0.29**	0.18	-0.14	0.31**
NL							0.34**	0.29**	0.11	0.06	0.08	-0.02	0.00	0.19	0.17	0.13	0.24*	-0.05	0.18	-0.11
REL								0.49**	-0.09	-0.06	-0.02	0.02	0.04	0.02	0.04	0.14	-0.01	-0.01	0.07	-0.11
LEL									-0.22*	-0.07	-0.01	0.20	0.12	0.00	0.06	0.21	0.04	-0.02	0.19	-0.12
HC										0.40**	0.28**	-0.49**	0.30**	0.57**	0.26*	0.20	0.47**	-0.28**	0.10	0.14
RHL											0.95**	0.06	0.00	0.24*	0.46**	0.18	0.51**	-0.09	-0.10	0.34**
LHL												0.13	-0.06	0.18	0.44**	0.19	0.48**	-0.07	-0.08	0.36**
CL													0.06	-0.31**	0.08	-0.03	0.03	0.00	0.11	0.17
LL														0.23*	0.09	-0.05	0.00	0.04	0.02	0.03
BL															0.34**	0.01	0.21	0.09	-0.09	0.03
CD																0.17	0.56**	0.35**	-0.11	0.20
SW																	0.10	-0.42**	0.47**	-0.19
HG																		0.01	0.10	0.32**
HW																			-0.60**	0.20
HL																				-0.29**
TL																				

BW=Body Weight, WH = Wither Height, HH=Hip Height, FL=Face length, FW = Face Width, NL=Neck length, REL = Right Ear Length, LEL = Left Ear Length Left, HC = Head Circumference, RHL = Right Horn Length, LHL =Left Horn Length, CL= Cannon length, LL=lateral length, BL= Body Length, CD = Chest Depth, SW = Shoulder Width, HG=Heart Girth, HW=Hip Width, HL= Hip Length, TL = Tail length, * = P < 0.05, ** = P < 0.01

Table 2: Pearson Correlation between Body Weight and Morphometric Traits of Boer goats

	BW	WH	HH	FL	FW	NL	REL	LEL	HC	RHL	LHL	CL	LL	BL	CD	SW	HG	HW	HL	TL
BW		0.73**	0.72**	0.66**	0.49**	0.5**	0.09	0.12	0.55**	0.66**	0.67**	0.27*	0.65**	0.71**	0.75**	0.48**	0.86**	0.40**	0.42**	0.15
WH			0.92**	0.6**	0.62**	0.52**	0.1	0.18	0.48**	0.62**	0.63**	0.58**	0.63**	0.64**	0.63**	0.60**	0.75**	0.24	0.54**	0.30*
HH				0.58**	0.64**	0.54**	0.19	0.18	0.50**	0.65**	0.66**	0.59**	0.58**	0.63**	0.64**	0.56**	0.74**	0.21	0.54**	0.31*
FL					0.5**	0.3*	0.39**	0.35**	0.62**	0.60**	0.61**	0.21	0.56**	0.61**	0.55**	0.39**	0.69**	0.45**	0.28*	0.02
FW						0.45**	0.12	0.36*	0.30*	0.56**	0.61**	0.40**	0.45**	0.58**	0.64**	0.23	0.51**	0.49**	0.29*	0.49**
NL							0.17	0.25	0.13	0.33**	0.34**	0.14	0.32*	0.44**	0.57**	0.41**	0.50**	0.17	0.43**	0.36**
REL								0.72**	0.07	0.36**	0.38**	-0.12	0.14	0.29*	0.24	-0.08	0.16	0.24	-0.14	0.15
LEL									0.09	0.39**	0.42**	0.03	0.11	0.37**	0.31*	-0.07	0.16	0.23	-0.08	0.23
HC										0.49**	0.52**	0.17	0.42**	0.46**	0.38**	0.37**	0.59**	0.27*	0.36**	-0.1
RHL											0.95**	0.2	0.51**	0.70**	0.73**	0.29*	0.78**	0.56**	0.12	0.15
LHL												0.21	0.50**	0.69**	0.74**	0.27*	0.77**	0.57**	0.18	0.18
CL													0.14	0.19	0.03	0.41**	0.25	-0.27*	0.66**	0.30**
LL														0.67**	0.60**	0.40**	0.65**	0.40**	0.24	0.13
BL															0.77**	0.34*	0.71**	0.57**	0.26	0.23
CD																0.22	0.79**	0.65**	0.14	0.26
SW																	0.59**	-0.04	0.59**	-0.07
HG																		0.45**	0.42**	0.07
HW																			-0.26	0.09
HL																				0.08
TL																				

BW=Body Weight, WH = Wither Height, HH=Hip Height, FL=Face length, FW = Face Width, NL=Neck length, REL = Right Ear Length, LEL = Left Ear Length Left, HC = Head Circumference, RHL = Right Horn Length, LHL =Left Horn Length, CL= Cannon length, LL=lateral length, BL= Body Length, CD = Chest Depth, SW = Shoulder Width, HG =Heart Girth, HW=Hip Width, HL= Hip Length, TL = Tail length, * = P < 0.05, ** = P < 0.01