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Abstract

This study was conducted at the Teaching and Research Farm of the Department of Animal Science, Ahmadu Bello University, Zaria, Nigeria to determine the relationships between body measurements, testicular and seminal characteristics using 31Red Sokoto bucks. The body condition was scored on a scale of 1 to 5 and then used to categorize the bucks into score 3 and 4. The linear body measurements {heart girth (HG), stature (ST), chest width (CW), withers height (WH), body depth (BD), body length (BL) and rump width (RW)} were measured in centimeters (cm) using flexible tape. The testicular measurements {testicular length (TL), testicular circumference (TC), were measured using flexible tape while testicular width (TW) and testicular weight (TWT) were estimated using the appropriate formulae}. The semen characteristics {semen volume, sperm motility, semen pH, sperm concentration and live and dead ratio were accordingly determined}. The study lasted for one year (July, 2011 – June, 2012). The results showed that, body measurements related positively amongst themselves (0.31 – 0.99), withobserved highest relation of (0.99) between BW and HG. Testicular characteristics werestrongly and positively correlated (0.77 – 1.0) amongst themselves. TW and TC related perfectly(1.0). The measured semen characteristics were positively related (0.47 – 0.85) amongst themselves. However negative relationship (-0.37) was observed between pH and semen volume. Body measurements related positively with testicular measurements (0.25 – 0.61). Rump width and Wither height related strongly with testicular characteristics. Body (0.27 – 0.45) and testicular (0.25 – 0.39) measurements were positively related to semen characteristics. However, the relationship between semen pH and volume was negative (-0.37); it was equaly negative with testicular dimension (-0.31 to -0.37) andbody measurements (-0.29 to -0.41). The study revealed that the positive and significant correlated relationships of body measurements with semen traits; and testicular measurements with semen characteristics indicate that, bucks with larger body size would possess larger testicular size and hence,they would produce higher semen volume andincreased sperm concentration. Therefore, these characteristic are useful in evaluating Red Sokoto bucks for breeding soundness and genetic improvement for fertility.

Keywords: Semen, Body Conformation, Red Sokoto Goat, Testicular Measurement

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Introduction

Breed characterization has accordingly been recognized as the first approach to the sustainable use of animal genetic resource (Lanari *et al.*, 2003). It is believed that various breed characteristics provide to some extent reasonable economic indicators. Body size and shape are important traits in meat animals. The characterization of local genetic resources depends on the knowledge of the variation of morphological traits, which have played a very fundamental role in classification of livestock based on size and shape (Ferra *et al*., 2010; Agga *et al*., 2010; Leng *et al*., 2010; Yakubu *et al*., 2010). Based on body conformation, meat production can better be estimated than other production properties making body measurements important selection criteria (Bene *et al*., 2007). Body weight is often the most common and informative measure of animal performance (Adeyinka and Mohammed, 2006). It has been found very effective in assessing the reproductive efficiency and performance in goats (Bongso *et al*., 1984) and provide readily obtainable and informative measure for selection, feeding and health care (Thiruvenkanden, 2005).

Numerous studies have been carried out on the linear measurements of Nigerian breeds of goats and their relationship among economic characteristics, reproductive performance and possible use for estimating the animals' live weight (Akpa *et al*., 2010; Adeyinka and Mohammed, 2006), but very few have explored the use of testicular measurements for the same purpose. However, measures of testicular size have received considerable attention as possible selection criteria for improving fertility in goat, primarily because of their high heritable (Toe, 2000). Land *et al*. (1982) have shown testicular growth and development to be closely related to body size. Bongso *et al*., (1984) reported that males with higher values of testicular parameters had higher body weight. Scrotal circumference (SC) has also been reported to be highly correlated both with testis weight (Coulter and Foote, 1976) and with spermatozoa output in growing bulls (Amann, 1970). These testicular traits also are heritable (Coulter *et al*., 1976; Stemmler *et al*., 1973).

Other findings that examined the relationship of testicular measurements with semen characteristics suggested the use of scrotal size and testicular measurements to select for superior sperm production rates. If these traits are to be considered for incorporation into management and breeding programs it is desirable that their relationship to other traits be understood.

The recognition of the reproductive characteristics of a goat breed is an essential starting point towards improving its productivity. Characterization of puberty and early sexual development is a valuable tool for selection within the males of a breed (Madani *et al*., 1989).Maintaining a high fertility by genetically superior bucks producing large numbers of high quality spermatozoa, is important for the improvement of overall flock fertility (Rege*etal*., 2000). Any quantifiable physical parameters that directly correlate with the fertilization capacity of semen could be potentially used as a measure of semen quality. Sperm production and quality can be affected by both animal size and physiological status (Akpa *et al*., 2012).

By using bucks with a high concentration of spermatozoa in their testes, more does per buck can be employed; conception rates would increase and the percentage of non-pregnant does would be reduced (Gherardi *et al*., 1980). However, evidence of a relationship between testicular size and spermatological characteristics is inconclusive. While some researchers suggested that testicular size provided a good index of testicular sperm output in rams (Lino, 1972), others reported that biweekly scrotal measurements were poorly correlated with semen quality in adult rams (Langford *etal*., 1998). Fernandez *et al*. (1990) did not record a relationship between testicular size and sperm production. These conflicting data justify the need for further studies on the relationship between testicular measurements and semen characteristics in bucks.

The quality of semen in relation to fertility is determined by the volume of ejaculate, sperm concentration and motility, percent of live sperm and the sperm morphology. The knowledge on correlations of male reproductive traits among themselves and with other variables such as weight, body conformation traits and testicular size might have important bearings to indicate the real producing ability of a male for sperm output and quality of semen. Therefore, the objective of this study is to evaluate the relationship between body measurements, testicular and seminal characteristics of Red Sokoto buck.

Materials and Methods

The study was conducted at the Experimental and Research Farm of the Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Zaria, Nigeria. The area is situated between latitude 11^0 and 12^0N and altitude of 640m above sea level (Encarta Encyclopedia, 2009 PC version). The area falls within the Northern-Guinea Savannah Zone, having an average annual rainfall of 1100mm, which starts from late April or early May to mid-October. The peak rainy season is between June and September, followed by the harmattan period of cool and dry weather which last from October to January. This is then followed by hot-dry weather from February to April. The mean maximum temperature varies from 26^0C to 35^0C depending on the season, while the mean relative humidity during harmattan period and wet season are 21% and 27%, respectively. Detailed description of Zaria was given elsewhere by Akpa *et al*. (2002).

A total of thirty-one Red Sokoto bucks were used for the study. The animals were under the management practice of the Department of Animal Science, Ahmed Bello University, Zaria. The bucks were reared under semi-intensive system. The animals were released daily for grazing at 8.00am and another shift by 2.00 pm.

Supplemental feed (concentrates) were provided. Animals received routine inspection and dipping (ectoparasite), as well as anti-helminthic drenching (deworming) and vaccination againt endemic diseases. Drinking water was provided *ad libitum.* The experiment commenced when the bucks were 9 – 12 months of age in July 2011 and ending when they were 21 – 24 months, in June, 2012. Sampling of bucks commenced when they were 9-12 months of age and terminated a year after when they were 21-24 months of age. The body weight of the bucks was measured in kilograms by following the procedure as described by Akpa *et al*. (1998). The weight of the observer was taken first, and then the body weight of each animal was taken by carrying the animal individually and standing on a weighing scale. The difference between this weight and that of the observer gives the weight of the animal. Weighing was done at the begining of the study and subsequently on monthly basis. A total of 372 records were generated for body weight.

Measurement of linear conformation traits were taken on the day of measurements in centimeters (cm) using flexible tape as described by Alphonsus *et al*. (2009) and Boisot *et al*. (2002). The measurements were taken at the onset and subsequently on monthly basis. A total of 372 records were generated for each of the body linear measurements.

Where:
Heart Girth (HG): This is the circumference of the body at a point immediately behind the fore limbs and perpendicular to the body axis.
The Stature (ST): This was measured from the top of the spine in between the hips to the ground.
Chest Width (CW): This was measured from the inside the surface between the topof the front legs.
The Wither Height (WH): This is the highest point over the scapular vertically to the ground.
Body Depth (BD): This is the distance between the top of the spine and the bottom of the barrel at the last rib.
Body Length (BL): This was measured from the point of shoulder to the ischium.
Rump Width (RW): This is the distance between the most posterior points of pin bones

Testicular measurement:

These were done at the onset and subsequently on weekly basis before semen collection. A total of 1488 records were generated for each of the measurement. The measurements were as follows:

***Testicular Length* (TL)**: This was measured in centimeter with a flexible measuring tape as the distance along the caudal surface of the scrotum, from its point of attachment to the tip of the scrotum as described by Akpa *etal*. (2012) and Bratte *et al*. (1999).

***Testicular Circumference* (TC):** This is the maximum dimension around the pendulous scrotum after pushing the testes firmly into the scrotum (Akpa *et al*., 2006). It was measured in centimeters (cm)

Testicular Width (TW): This was taken as the division of Testicular Circumference by two.

Testicular Weight (TWT): This was determined using Bailey *et al.* (1996) formulae as given below;

$$TWT = 0.5533 \times TL \times TW^2$$

Where; TWT = Testicular weight
TL = Testicular length
TW = Testicular width

Body Condition Score (BCS)

The body condition score (1-5) were employed to score the bucks. The buck's backbone, loin and rump areas were palpated and examined and then scored. These areas do not have muscle tissue covering them, hence, combination of skin and fat deposit account for any cover that were felt around these areas. Amount of fat deposit can be determined by the use of fingertip pressure which is exerted on the backbone, pin bone and hip bone, respectively.

Score 1 (Very Thin)*:* Individual short ribs have a thin covering of flesh. Bones of the chine, loin and rump region are prominent. Hook and pin bones protrude sharply, with a very thin covering of flesh and deep depressions between bones. Bony structure protrude sharply and ligament prominent.

Score 2 (Thin)*:* Individual short ribs can be felt but are not prominent. Each rib is sharp to touch but have a thicker covering of flesh. Short ribs do not have as distinct an over-hanging shelf effect. Individual bone is the chine, loin and rump regions are not visually distinct but easily distinguishable by touch. Hook and pin bones are prominent but the depression between them is less severe. Area below tail head and between pin bones is somewhat depressed but the bony structure has some covering of flesh.

Score 3 (Moderate)*:* Short ribs can be felt by applying slight pressure. Altogether, short ribs appear smooth and the over-hanging effect is not so noticeable. The backbone appears as a rounded ridge, firm pressure is necessary to feel individual bones. Hook and pin bones are rounded and smooth. Area between pin bone and around tail head appears smooth without sign of fat deposit.

Score 4 (Fat)*:* Individual short rib is distinguishable only by firm palpation. Short ribs appear flat or rounded, with no overhanging shelf effect. Ridge formed by backbone in chine region is rounded and smooth. Loin and rump region appear flat. Hooks are rounded and the space between them is flat. Area of tail head and pin bones is rounded with evidence of fat deposit.

Score 5 (Obese)*:* Bony structures of backbone, short ribs and hook and pin bones are not apparent; subcutaneous fat deposit very evident. Tail head appears to be buried in fat tissue.

Semen Collection and Evaluation

Semen samples were collected from each animal at the onset and thereafter on weekly basis for 52 weeksusing an electro-ejaculator and were labeled accordingly. This was done in the morning hours throughout the duration of the experiment. Smear of each semen sample was prepared; air dried, labeled and kept for further examination,vis determination of sperm concentration using formaldehydeand determination of live/dead ratio using eosin nigrosin.

Semen Concentration

The concentration of the spermatozoa was determined using the Red Blood Cell counting chamber of a haemocytometer that were crossed with microscopic grids containing 25 large squares with each containing sixteen smaller squares. The total number of smaller squares on the haemocytometer is 400. Sperm cells were counted diagonally from top left to the bottom right and from top right to the bottom left in five large squares or a total of 80 smaller squares (Rekwot *et al*., 1997).Prior to counting, formaldehyde was used as a dilution reagent. A drop of semen was taken from each sample using automatic pipette and diluted with formaldehyde at 1:100. The haemocytometer was mounted into the microscope and an absorbable tube and O-no pette was used to pipette a drop of the solution into the haemocytometer chamber. The absorbable tube and the O-no pette were blown before pipette to avoid air bubbles in the O-no pette. After appropriate counting in the 5 large squares, the number obtained was multiplied with 100 (dilution factor), 16 (the number of smaller squares in a larger square and the volume of the semen sample collected, multiplied by 10^6). The result obtained was recorded as the sperm cell concentration for the sample.

Live and Dead Ratio

The live and dead ratio was estimated by the preparation of a smear of individual semen sample using eosin-nigrosin stain immediately after collection. A drop of semen was diluted and placed on a clean glass slide using automatic pipette. A drop of the eosin-nigrosin solution was placed alongside the semen on the slide. A gentle circular turning of the slide was done to allow a uniform mixture of the two samples. A one-quarter of the part of another clean slide was placed on top of the first sample and the two slides were gradually and carefully drawn apart to prepare a thin smear on the first slide. This was allowed to dry and thereafter labeled. This was done for each sample and they were later mounted on the microscope for counting the live and dead sperm cells. The principle is that the dead sperm cells accept the stain and appear stained while the live sperm cells reject the stain and remain unstained. The procedure above was developed by Hancock (1951)**.**

Correlation analysis procedure of SAS (2002) was used to assess the relationship between the measured characteristics. The monthly data on body weight and body conformation traits were used to determine the relationships between them, giving rise to a total of 372 records for each traits. Also, the weekly data (1488 records) on testicular and seminal traits were used for estimating thier relationships. However, to estimate the relationship of testicular and seminal triats with body weight and body conformation traits, their weekly observations were averaged for each month to get a comparative value to the monthly body measurements.

Results and Discussion

Table 1 shows the correlation analysis between body conformation traits in Red Sokoto bucks. Positive and significant (P<0.01-0.05) correlations of (r = 0.3 – 0.99) were observed among various conformation traits. BW had the highest positive correlation with HG (r = 0.99), followed by WH with ST (r = 0.83). BCS had positive correlation with BW (r = 0.82) and with HG(r =0.81), respectively.

The correlation analysis between testicular characteristics is presented in Table 2. Highly positive and significant (P<0.01) correlations (r = 0.77 – 1.0) wereobserved among the testicular characteristics. Perfect positive correlation was obtained between TW and TC (r = 1.0).Strong positive correlation was observed between TWT and TC (r = 0.83) and between TWT and TW (r = 0.83), respectively.

Table 3 shows the correlated relationship between semen characteristics. The measured characteristics were positively correlated (r = 0.47 – 0.85) amongst themselves. However negative and significant (P<0.05) correlation (r = -0.37) was observed between pH and semen volume. Other correlations were close to zero or not significant and two of such relationships were negative (live/dead ratio and concentration; and live/dead ratio and pH).

The correlation analysis between body and testicular conformations is shown in Table 4. Testicular length was positively and significantly correlated with ST, WH, and RW (P<0.05; r = 0.25 – 0.36) but not with BW, BCS, HG, CW,and BD (P>0.05; r = 0.00 –0.2). It had negative non-significant correlation with BL (P>0.05; r= -0.05).

Testicular circumference and testicular width were positively and significantly correlated with body measurements (P<0.05-0.01; r = 0.42 – 0.61) except BW, BCS and HG (P>0.05; r = 0.19 – 0.23). Testicular weight was positively and significantly correlated with body measurements (P<0.05-0.01; r = 0.25 – 0.60) except BW and HG (P>0.05; r = 0.13). Rump width and wither height had the strongest correlations with testicular characteristics.

The result of the correlation analysis between body conformation and semen characteristics is presented in Table 5. Semen volume was positively and significantly correlated with BW, BCS and linear body measurements (P<0.05 – 0.01; r = 0.27 –0.48) except BD (P>0.05; r = 0.18). The semen pH was negatively and significantly correlated with BW,BCS and body measurements (P<0.05; r=-0.29 to -0.41), except BL, BD and RW where though negative,it showed no significant correlation. Live/dead ratio was positively and significantly correlated with BW, BCS and HG (P<0.05; r=0.30 – 0.39) but not significantlycorrelated with ST, CW, BL and RW (P>0.05; r=0.03 – 0.13); and not positively and significantly correlated with WH and BD (P>0.05; r = -0.02 to -0.01). Other correlation (sperm motility and concentration)were close to zero or not significantly correlated with BW and linear body measurements and three of such relationships were negative with sperm motility and concentration respectively (BW,HG and BL with sperm motility and BL, BD and RW with sperm concentration).

Table 6shows the correlated relationships between testicular measurements and semen characteristics in Red Sokoto bucks. The result showed that the semen characteristics were positively and significantly correlated with testicular measurements (P<0.01-0.05; r=0.25-0.39) except semen pH which was negatively and significantly correlated with testicular measurements (P<0.05; r= -0.31 to -0.37).Semen volume had the strongest positive correlation with TWT (r = 0.39); followed by sperm motility with TL (r = 0.38), and Live/dead ratio with TL, TC and TW, respectively.

Positive and highly significant (P<0.01) correlations (r = 0.3 – 0.99) among various conformation traits indicated that the traits were linked. The correlation of r = 0.99 between body weight and chest girth; and r = 0.82 between body weight and body condition score, respectively, indicate strong relationships or degree of association between these variables. Ford *et al*. (2009) reported correlation of r = 0.98 and 0.60 in Kiko bucks, while Keith *et al*. (2009) reported lower correlation of r = 0.84 and 0.653in pubertal Boer buck, respectively,for body weight and heart girth; and for body weight and BCS. Thompson *et al*. (1983) had reported BW to BCS correlation of r= 0.75 in Angus cows which is similar to the present study. These results indicate that the degree of fleshiness or fatness is an important consideration when evaluating theweights of goat.

Okpeku*etal*. (2011) reported correlation of r = 0.91 for body weight and heart girth in Red Sokoto buck while Rahman *etal*. (2008);and Yakubu and Mohammed (2012) reported the same value (r = 0.91)for body weight and heart girthcorrelation in black Bengal buck and Red Sokotogoats,respectively. These findingsare similar to the present study.The strongestcorrelation coefficient observedbetween BW and HG (r = 0.99) in this study isconsistent with r = 0.99 observed byAdeyinka and Mohammed (2006) in Red Sokoto goats and r = 0.98 observed by Ford *etal.* (2009) in Kiko bucks as well as r = 0.93 observed by Ojedapo*etal*. (2007) in WAD.The relationship between body weight and heart girth can be explained by intimate association between body weight and growth of muscles, bones and visceral organs (Prasad*etal*.,1981), thus indicating that heart girth may be used as a predictor of body weight.

The results of the present study werehigher than the findings of Khan *etal*. (2006) who observed positive correlation of (r = 0.64) between body weight with heart girth.Thesignificant correlations between body weight and linear traitsshowed that various conformation traits could be used as alternatives to body weight as indicators of growth. It also indicates that an increase in any one of the body measurement would result in a corresponding increase in live body weight, thereby signifying that either one or the combination of these linear traits would estimate live weight in goats fairly well in the situation where scales are not available. The association could be used as selection criterion since positive correlations of these traits signify that the traits would be under the same genetic influence.

Testicular characteristics were positively correlated with each other (r = 0.81 – 1.0; P <0.01). Testicular circumference could provide a useful estimate of testicular growth since its correlations with the other testicular measurements was the strongest.Meeting or exceeding minimal scrotal circumference values based upon buck's age may serve as a requirement for selection of bucks for breeding. The present results agreed with the findings of Salhab*etal.* (2001); and Koyuncu *et al*. (2000; 2005).The observed perfect correlation of r = 1.0 between the TC and TW in this study, is consistent with r = 0.97 reported by Oyeyemi and Ubiogoro(2005) in Nigeria large white boars; and r = 0.90 reported by Osinowo *et al*.(1977) in bull and close to r = 0.65 as reported by Ugwu (2009) in WAD buck.In the same vein, the correlation coefficient between testicular circumference and testicular weight (r = 0.83) as reported in this study is similar to the value of r = 0.79 reported by Raji *et al*. (2008) and same value by Keith *et al.* (2009) in Red Sokoto buck and pubertal Boer goat, respectively.

Koyuncu *et al*. (2005) reported correlation of r = 0.84 in Kivircik ram, while Ugwu, (2009) reported r = 0.72 in WAD buck for testicular circumference and length which are in consonance with r = 0.81 observed in the present study. However, Raji *et al*. (2008) reported higher value of r = 0.94 for the same traits in Red Sokoto bucks.This suggests that the testicular length is an indicator of testicular circumference.Moreover,r = 0.77 observed between TL and TWT in the present study is slightly higher than r = 0.67 reported by Kabiraj *et al*. (2011) in black Bengal bucks. The difference could be due to the effect of genotype or breed.

There appear to be interaction between testicular circumference andtesticular size in relation to the appearance of spermatozoa in the ejaculate. Rege *et al*. (2000)and Keith *et al*. (2009) suggested the use of scrotal size and testicular measurements in selecting for improved sperm production in breeding males.It seemed that not only is there a certain degree of scrotal circumference and testicular size required before sperm could be produced, but also a limit of chronological age below which puberty cannot be attained irrespective of the nutrient management regime applied. Hence, advantages would accrue from selecting bucks of higherthan-average scrotal circumference, even if it were unrelated to the fertility of the buck themselves. Yet whether or not it is justifiable to set acceptable standard scrotal circumference (testis size) for meat goat bucks breeds is open to debate, and requires further investigation.

Volume of semen showed no significant correlation with live/dead ratio (r=0.06), but showed positive and significant correlation with sperm concentration indicating that the higher the semen volume the more will be the concentration of spermatozoa. This is supported by Webb *et al*. (2004) who observed similar trend. Kabiraj *et al*. (2011) reported correlation of r = 0.77 between semen volume and sperm concentration in black Bengal bucks, which is higher than the value obtained in the present study. However a negative but significant correlation was observed between semen volume and pH (r=-0.37) in the bucks. This suggests that in these bucks, semen volume is not a good predictor of semen pH and motility. This agreed with Alkass and Ahmed (2011) who reported correlation of r = -0.36 between semen volume and pH in black goat and Meriz bucks, respectively.Semen pH showed a negative non-significant correlation with live/dead ratio (r=-0.10), but a positive and significant correlation with sperm concentration (r=0.38), indicating that pH of the semen is a good indicator of sperm concentration. It has been observed that pH depends upon sperm concentration and that a good sperm concentration has an acidic pH (Barnabe *et al*. 1992; Younis, 1996). The observed positive and significant correlation of sperm motility with live/dead ratio indicates that the number of live or dead spermatozoa observed in the semen of the bucks depends on the progressive active movement of the sperm. Thisis supported by Alkass and Ahmed (2011) in black goat and Meriz bucks, respectively.

The positive and significant correlation between testicular dimensions and some of the body measurements signify that males with larger scrotal size would possess larger body size and good reproductive ability. Testicular length and circumference are measures of testicular size which had been found to be significantly correlated with bodyweight (Adedeji and Gbadamosi, 1999; Bratte *et al*, 1999). However, Adedeji and Gbadamosi (1999) reported higher value (70) but this study reported up to (61). The differences could be attributed to breed, genotype and environmental factors. A significant correlation between testis weight and wither height and the correlation between testis weight and rump width could be used in selecting animals for breeding program such as when artificial insemination is required. The present results are consistent with the report of Waheed *et al*. (2011) who reported similar trend, the authors reported correlation of r = 0.347 between testicular length and wither height; and r = 0.36 between testicular length and rump width, respectively in Pakistani Beetal male goats, which are consistent with r = 0.36 and 0.31 obtained in the present study. In the same vein, Waheed *et al*. (2011) also reported r = 0.52 and 0.43 between testicular circumference and wither height; and between testicular circumference and rump width respectively, which are similar to r = 0.61 obtained for both relationships in the present study. Ford *et al*. (2009) also reported r = 0.76 between testicular circumference and wither height which is consistent with r =0.61 reported in the present study.

Maintaining a high fertility by genetically superior bucks producing large numbers of high quality spermatozoa, is important for the improvement of overall flock fertility (Rege *et al*., 2000). Information on body measurement and semen characteristics helps in the possibility of improving fertility of animals generally (Akpa *et al*.2012). By using bucks with a high concentration of spermatozoa in their testes, more does per buck can be employed; conception rates would increase and the percentage of non-pregnant does would be reduced (Gherardi *et al*., 1980). The present study showed a positive and significant relationship between semen volume and body measurements except body length. This signifies that bucks with good body size would produce higher semen volumeand more concentrated spermatozoa. The positive and significant correlation between WH and semen volume and non-significant correlation of semen volume with body length are supported by Okere *et al*. (2011) who reported the same trend. The use of an electro-ejaculator has been reported to yield larger ejaculate volume and lower concentration of spermatozoa than using an artificial vagina but the total sperms/ejaculate and the fertility of spermatozoa are similar using both techniques (Kridli, 2007; Bearden and Fuquay, 1997).This may be attributed tonon-significant effect of body measurementswith sperm concentration as observed in the present study.

The positive relationships observed between semen quality attributes and testicular dimensions indicate that an improvement in one would lead to improvement in the other. However, semen pH related negatively with testicular dimensions; thus indicating that larger testicular dimensions would lead to lower semen pH. This study confirms that testicular weight and sperm concentration were positively correlated (r = 0.32) which agreed with the reports by Akpa *et al*. (2012) who reported r = 0.35 in Yankasa rams and Kabiraj *et al*. (2011) who reported higher value of r = 0.84 in black Bengal bucks.

In the present study, testicular measurements were significantly correlated with semen volume and sperm concentration which were to some extent similar to the observationsof other researchers (Rajuana*etal.,* 2008 in black Bengal buck; Elmaz *et al*., 2007 in Kivircik ram; Pant *et al*., 2003 in bull and Vasquez *et al*., 2003 in bull).The correlation of r= 0.27 between semen volume and TC reported by Noran *et al.* (1998) in Malaysianlocal Katjangbucks agreed with the result of the present study. Observed correlation values between testicular measurements and sperm concentration (0.25-0.32) indicated that testicular size is a good indicator of sperm production capability.

However, the negative but significant correlations of pH with the testicular measurementsindicate that,as testicular size increases, a decrease in seminal pH would be encountered in the bucks.This is supported by Akpa *et al*. (2012) and Noran *et al.* (1998)who reported the same trend. Scrotal circumference is an indirect measurement of testicular weight and a reliable indicator of testicular growth and spermatogenic capacity of the testis (Daudu, 1984). Likewise, testicular weight (TW) is a reliable variable for estimating the sperm production capacity of males. Together with the other variables, it can be used to select males for testicular size at puberty (Coulter *etal*., 1975).

Conclusion and Recommendations

Heart girth had the strongest correlation with body weight while height at withers was the strongest predictor of testicular dimensions in Red Sokoto bucks. Measurements of TC, TL and TW and their association with semen traits could provide a reliable guide in estimating testicular growth and sperm production capacity in Red Sokoto bucks. The relationships of semen volume with body and testicular measurements; and sperm concentration indicate that they are useful in evaluating bucks for breeding soundness and genetic improvement for fertility in Red Sokoto bucks.

Refereneces

Adedeji, O.S. and Gbadamosi, A.J. (1999). Relationship of scrotal circumference to age, bodyweight andthe right and left scrotal length in the red Sokoto goats. *In:Proceedings of 26th annual Conference of NigeriaSociety for Animal Production*, 21-25 March, Ilorin, Nigeria.

Adeyinka, I.A. and Mohammed, I.D. (2006). Relationship of live weight and linear body measurement in two breeds of goats of Northern Nigeria. *Journal of Animal andVeterinary Advances.* 5(11): 891-893.

Agga, G.E., Udala, U., Regassa, F. andWudie, A. (2010). Body measurements of bucks of three goatbreeds in Ethiopia and their correlation to breed, age and testicular measurements.*SmallRuminant. Research*, 95 (2): 133–138.

Akpa,G.N., Abdulkareem, M.S., Muhammed, I.R. and Alphonsus, C. (2010). Effect of breed andage on measures of growth and scrotal size in rams. *Nigeria Journal of AnimalScience*,12:1-6.

Akpa, G.N., Alphonsus, C., Duru, S. and Abdulrashid, M. (2006). Factors affecting body sizeand horn length in small holder rams. *Savannah Journal of Agriculture*, 1(2):130-137.

Akpa G.N., Duru, S.and Amos, T.T. (1998). Influence of strain and sex on estimation of withinage group body weight of Nigerian Maradi goats from their linear bodymeasurements.*TropicalAgriculture. (Trinidad)*. 75: 462-467.

Akpa, G.N., Ifut, O.J. and Mohammed, F. (2002). Indigenous management of Dystocia inruminant livestock of northern guinea savannah of Nigeria. *Nigeria JournalAnimalProduction*, 29 (2): 264-270.

Akpa, G.N., Suleiman, I.O. and Alphonsus, C. (2012). Relationships between Body and Scrotal Measurements, and Semen characteristics in Yankasa ram. *Continental Journal of AnimalandVeterinary Research* 4 (1): 7 – 10.

Alkass, J. and Ahmed, K.A.A. (2011). Comparative study on some semen characteristics andtestosterone level of Black goat and Meriz bucks. *Journalof Duhok University*.14 (1): 1-8.

Alphonsus,C., Akpa, G.N. and Oni, O.O. (2009).Repeatability of objective measurements of linear udder and body conformation traits in Frisian x Bunaji cows. *AnimalProductionResearch Advances*, 5(4): 224-231.

Amann, R. P. (1970). Sperm production rates. In A. D. Johnson, W. R. Gomes and N. L. VanDemark(Ed.). The Testis. *Academic Press*, NY, 1: 433-482.

Bailey, T.L., Monkey, D., Hudson, R.S., Wolfe, D.F., Carson, R.L. and Ridell, M.G. (1996). Testicular shape and its relationship in sperm production of matured Holstein bulls. *Theriogenelogy*, 46: 881-887.

Barnabe, V.H., Barnabe, R.C., Appuda, R.P., Visintin, J.A. andFreitas, M.T.L.(1992):Seasonal behaviour of semen collection by electro ejaculation from buffaloes raised inSao Paulo State (Southeast Brazil). *12th International Conference on Reproduction*, Hague,Netherlands 4: 484-489.

Bearden, H.J. and Fuquay,J.W. (1997). Applied animal reproduction. *4th Ed. Prentice Hall*, New Jersey. Pp: 145-156.

Bene, S., Nagy, B., Nagy, L., Kiss, B., Polgar, J.P. andSzabo, F. (2007). Comparison of bodymeasurements of beef cows of different breeds. *Arch. Tierz. Dummerstorf*, 50: 363-373.

Boisot, P.O., Rodriguez-zas, S.L. and Shanks, R.D. (2002). Repeatability of objective measurements on the rear legs of Dairy cows. *Journal of Dairy Science.* 85: 2344-2351.

Bongso, T.A., Hassan, M.D. and Novelin W. (1984). Relationship of scrotal circumference and testicular volume to age and body weight in swamp buffalos. *Theriogenology*. 22:127-134.

Bratte, L.,Arijeniwa, A. and Ikhimioya, A.I. (1999). Age and Body weight and their relationship with testicular and horn development in Yankasa West African dwarf crossbredrams.*Journal of Applied Animal Research*, 15(2):201-206.

Coulter, G.H. and Foote, R.H. (1976). Relationship of testicular weight to age and scrotal circumference of Holstein bulls. *Journal of Dairy Science*. 59:730-735.

Coulter, G.H., Larson, L.L. and Foote, R.H. (1975). Effect of age on testicular growth and consistency of Holstein and Angus bulls. *Journalof Animal Science*. 41:1383-1389.

Coulter, G.H., Rounsaville, T.R. and Foote, R.H. (1976). Heritability of testicular size and consistency in Holstein bulls. *Journal of Animal. Science*. 43:9-13.

Daudu, C.S., (1984). Spermatozoa output, testicular sperm reserve and epididymal storage capacity of the Red Sokoto goats indigenous to northern Nigeria. *Theriogenology*,21: 317-324.

Elmaz, O., Cirit, U. and Demir, H. (2007). Relationship of testicular development with age, body weight, semen characteristics and testosterone in Kivircik ram lambs. *SouthAfrican Journal of Animal Science*, 37: 4-8.

Encarta Encyclopedia, (2009) PC version. Study tools, a Multimedia Encyclopedia, Dictionary and an atlas. Microsoft Student with Encarta Premium, DVD 2009.

Fernandez, P.A., McCoshen, J.A., Cheang, M., Kredentser, J.V. and Wodzicki, A.M. (1990). Quantitative analysis of the effect of freezing on donor sperm motion kinetics.*Fertility and Sterility*, 54(2): 322–327.

Ferra, J.C., Cieslak, S., Filho, R.S., McManus, C., Martins, C.L., Sereno, J.R.B. (2010). Weight andage at puberty and their correlations with morphometric measurements incrossbreedSuffolk ewe lambs. *RevistaBrasileira de Zootecnia*, 39: 134-141.

Ford Jr, D., Okere, C. and Bolden-Tiller, O. (2009). Libido test scores, body conformation and testicular traits in Boer and Kiko goat bucks.*ARPN Journal of Agricultural and Biological Science*. 4 (5): 1-8.

Gherardi, P.B., Lindsay, D.R. and Oldham, C.M. (1980). Testicle size in rams and flock fertility. *Proceedings of Australia Society of Animal Production*. 13: 48-50.

Hancock, J I. (1951). A staining technique for the study of temperature shock in semen. *Nature, London*, 197: 323-343.

Kabiraj, S.K., MasudulHoque, S.A., Khandoker, M.A.M.Y. and Husain, S.S. (2011). Testicular biometry and its relationship with body weight and semenoutput of blackBengal bucks in Bangladesh. *Journal of Cell and Animal Biology*, 5(2): 27-32.

Keith, L., Okere, C., Solaiman, S. and Tille, O. (2009). Accuracy of Predicting Body Weights from Body Conformation and Testicular Morphormetry in Pubertal Boer Goats. *Research Journal of Animal Sciences*, 3 (2): 26-31.

Khan, H., Muhammad, F., Ahmad, R., Nawaz, G., Rahimullah and Zubair, M. (2006). Relationship of body weight with linear body measurements in goats. *Journalof Agriculture andBiologicalSciences*, 1: 51-54.

Koyuncu, M., Kara Uzun, S., Ozis, S. andDuru, S. (2005). Development of testicular dimensions and size, and their relationship to age and body weight in growingKivircik(Western Thrace) ram lambs. C*zech Journal ofAnimal Science,* 50 (6): 243–248.

Koyuncu, M., Şengü, L.and Tuncel, E. (2000). Some of thetesticular characteristics of black collarlambs. *Animal Production*, 41: 102–107.

Kridli, R.T., Tabbaa, M.J. and Barakeh, F.S. (2007). Seasonal Variation in Scrotal Circumference and Semen Characteristics of Black Bedouin and Black Bedouin-DamascusCrossbredBucks. *Asian Australian Journalof AnimalScience*, 20(3): 359-364.

Lanari, M.R., Taddeo, H., Domingo, E., Centeno, M.P. and Gallo L. (2003). Phenotypic differentiation of exterior traits in local Criollo goat population in Patagonia (Argentina). *ArchTierzDummerstorf*, 46: 347–356

Land, R.B., Gauld, F.K., Lee, G.S. and Webb, R. (1982). Further possibilities for manipulating the reproductive process. In: S.F. Barker, K. Hammond and A.E. MacLintock.Furtherdevelopment in the genetic improvement of Animal. *Academic press,*Sydney, Australia.Pp: 59-87.

Langford, G.A., Shrestha, J.N.B., Sanford, L.M. and Marcus, G.J. (1998). ReproductiveHormoneLevels of Early Post Pubertal Ram Lambs in Relation to Breed, Adult TestisSize andSemen Quality. *Small Ruminant Research*. 29: 225 231.

Leng, J., Zhu, R., Zhao, G., Yang, Q. and Mao,H. (2010). Quantitative and qualitative body traits of Longling Yellow goats in China. *Agricultural Sciences in China*, 9: 408–415.

Lino, B.F. (1972). The output of spermatozoa in rams. II. Relationship to scrotal circumference, testis weight, and the number of spermatozoa in different parts of the urogenitaltract.*AustralianJournalof BiologicalScience,* 25: 359-366.

Madani, M.O.K., Rahal, M.S., Zawia, M.T. and Eluwhaishi, B.A., (1989). Puberty and early sexual development in Libyan fat tailed ram lambs. *Britain Veterinary Journal*, 145:276-288.

Noran, A.M., Mukherejee, T.K. and Abdullah, R. (1998). Semen Characteristics of LocalKatjangandCross-Bred (Katjang × German) Bucks.*Asian-Australian Journalof AnimalScience*, 11:445 -449.

Ojedapo, L.O., Adedeji, T.A., Olayeni, T.B., Adedeji, O.S., Abdullah, A.R. and Ojebiyi, O.O. (2007). Influence of Age and Sex on body weight and somebody linearmeasurements ofextensively reared WAD goats in derived Savannah zone of Nigeria. *Journal of Animaland Veterinary Advance*, 6 (1): 114-117.

Okere, C., Bradley, P., Bridges, E. R., Bolden-Tiller, O., Ford, D. and Paden, A. (2011). Relationships among Body Conformation, Testicular Traits and Semen Output in Electro-Ejaculate Pubertal KikoGoat Bucks.*ARPN Journal of Agricultural and Biological Science*, 6 (8): 43-48.

Okpeku, M., Yakubu, A., Peters, S.O., Ozoje, M.O., Ikeobi, C.O.N.,Adebambo, O.A., Imumorin, I.G. (2011). Application of multivariate principal component analysis to morphological characterization of indigenous goats in Southern Nigeria. *ActaArgiculturaeSlovenica,* 98(2):101–109.

Osinowo, O., Dennis, S.M., Osori, D.I.K. and Molokwu, E.C.I. (1977). Scrotal and Testiculardimensions in some West African bulls. *Nigerian Journal of Animal Production*.4: 31-36.

Oyeyemi, M. O. andUbiogoro, O. (2005). Spermiogram and morphological characteristics in testicular and epididymal spermatozoa of large white boar in Nigeria. *International Journal of Morphology*,23(3):235-239.

Pant, H.C., Sharma, R.K., Patel, S.H., Shukla, H.R., Mittal, A.K., Kasiraj, R.K., Misra, A.K. andPrabhakar,J.H. (2003). Testicular development and its relationship to semenproductionin Murrahbuffalo bulls. *Theriogen,* 60(1): 27-34.

Prasad, B., Singh, C. S. P. and Mishra, H. R. (1981). Note of body weight-measurement relationship in Black Bengal goats. *Indian Journalof AnimalScience,* 55: 880-882.

Rahman, A.H.M.S., Khandoker, M.A.M.Y., Husain, S.S., Apu, A.S., Mondal, A. and Nottera, D.R. (2008). Morphometric characterization and relationship of Body weight with linear body measurements in black Bengal buck. *Bangladesh Journalof AnimalScience*, 37 (2): 8 -16.

Raji, A. O., Igwebuike, J. U. and Aliyu, J. (2008). Testicular biometry and its relationship with body weight of indigenous goats in a Semi-Arid region of Nigeria. *Journal of Agricultural and Biological Science,* 3 (4):6-9.

Rajuana, A.K., Tayabur, M.R., Hoque, M.A., Husain, S.S. and Sultana, Z. (2008). Repeatability estimates for seminal traits and their phenotypic relationships with testes measurements andperformance traits in black Bengal buck. *Bangladesh Journalof AnimalScience*,37(2): 34 -41.

Rege, J.E.O., Toe, F., Mukasa-Mugerwa, E., Tembely, S., Anindo, D., Baker, R.L. and LahlouKassi, A. (2000). Reproductive characteristics of Ethiopian highland sheep II.Geneticparameters of semen characteristics and their relationships with testicularmeasurementsin ram lambs. *Small Ruminant Research*. 37, 173-187.

Rekwot, P.I., Oyedipe, E.O., Dawuda, P.M. and Sekoni, V.O. (1997). Age and hourly related changes of serum testosterone and spermiogram of pre-pubertal bulls fed two levels of nutrition. *The Veterinary Journal,* 153: 341-347.

Salhab, S.A., Zarkawi, M., Wardeh, M.F., Al-Masri, M.R. andKassem, R. (2001): Development of testicular dimensions and size, and their relationship to age, body weight and parental size in growing Awassi ram lambs. *Small Ruminal Research*.40: 187–191.

SAS. (2002). Statistical Analysis System, Computer Software, Version 9: Statistics SAS Institute Inc. Cary, NC 27513, NC27513, USA.

Stemmler, K.H.,Stemmler,H., Brilckner,G., Bach, S. andHaase, H. (1973).The influence ofButlenonthe fertilizingcapacity ofmaledescendants,testes onthe basisof semencharacteristics andfertilizingearnings. *Arch.Tierzucht*.16:315 -319.

Thiruvenkanden, A.K. (2005). Determination of best fitted regression model for estimation of body weight in KanniAdu kids under farmers' management systems. *LivestockResearchfor Rural Development*. 17(7): 76-87.

Thompson, W. R., Theuninck, D. H., Meiske, J. C., Goodrich, R. D., Rust, J. R. and Byers,F. M. (1983). Linear measurements and visual appraisal as estimators of percentage empty Body fat of beef cows. *Journal of Animal Science*. 56:755-756.

Toe, F. (2000). Reproductive characteristics of Ethiopian highland sheep: I. Genetic parameters oftesticular measurements in ram lambs and relationship with age at puberty in ewelambs. *Small Ruminant Research* 36: 227-240.

Ugwu, S.O.C. (2009). Relationship between scrotal circumference, in situ testicular measurements and sperm reserves in the West African dwarf bucks. *African Journal ofBiotechnology*, 8(7): 1354-1357.

Vasquez, L., Vera, O.andArango, J. (2003). Testicular growth and semen quality in peripuberalBrahman bulls. *Livestock Research for Rural Development*,15: 10-14.

Waheed, A., Khan, M.S., Ahmed, A.N., Tariq, M.M., Rauf, M. and Eyduran, E.(2011).Relationships among testicular traits, body measurements and bodyweight in Beetal malegoatsin Pakistan.*IğdırUniversity Journalof Institute ofScience and Technology*. 1(1):59-62.

Webb,E.C., Dombo, M.H. and Roets, M. (2004). Seasonal variation in semen quality of Gorno Altai cashmere goats and South African indigenous goats. *South African Journalof Animal Science ©South African Society for Animal Science Peer reviewed paper: 8th International Conference on Goats*,34 (1): 48-53.

Yakubu, A. and Mohammed, G.L. (2012). Application of Path Analysis Methodology in assessing the Relationship between Body Weight and Biometric Traits of Red Sokoto Goats in Northern Nigeria. *Biotechnology in Animal Husbandry*. 28 (1):107-117.

Yakubu, A., Salako,A.E. andImumorin, I.G. (2010). Multivariate analysis of spatial patterns of morphological traits in West African Dwarf goats in three agro-ecological zonesofNigeria. *Journalof AppliedAnimal Research*, 38: 257–260.

Younis, M. (1996). Studies on semen quality, freezability and fertility of buffalo bulls during low and peak breeding seasons. *Ph.D. Thesis. Department of Animal Reproduction, Universityof Agriculture*. Faisalabad, Pakistan.

Tables

Table 1: Correlated relationships between body conformation traits in red sokoto bucks

	BCS	HG	ST	CW	WH	BD	BL	RW
BW	0.82**	0.99**	0.50**	0.31*	0.33*	0.33*	0.49**	0.35*
BCS	-	0.81**	0.41*	0.36*	0.32*	0.36*	0.31*	0.43*
HG	.	-	0.49**	0.31*	0.32*	0.34*	0.49**	0.35*
ST	.	.	-	0.33*	0.83**	0.41*	0.63**	0.71**
CW	.	.	.	-	0.42*	0.33*	0.43*	0.65**
WH	.	.	.	.	-	0.60**	0.64**	0.75**
BD	.	.	.	.	.	-	0.60**	0.41*
BL	.	.	.	.	.	.	-	0.52**

** = P<0.01, * = P<0.05, BW: Body weight, BCS: Body condition score, HG: Heart girth, ST: Stature, CW: Chest width, WH; wither height, BD: Body depth, BL: Body length, RW: Rump width.

Table 2: Correlated relationship between testicular characteristics in red sokoto bucks

	TC	TW	TWT
TL	0.81**	0.81**	0.77**
TC	.	1.0**	0.83**
TW	.	.	0.83**

** = P<0.01, TC: Testicular circumference, TL: Testicular length, TW: Testicular width, TWT: Testicular weight

Table 3: Correlated relationship between semen characteristics in red sokoto bucks

	Motility	pH	Concentration	Live/dead ratio
Volume	-0.14	-0.37*	0.47**	0.06
Motility	-	0.01	0.13	0.85**
pH	.	-	0.38*	-0.10
Concentration	.	.	-	-0.03

** = P<0.01, * = P<0.05

Table 4: Correlated relationships between body and testicular conformations in red Sokoto bucks

	TL	TC	TW	TWT
BW	0.03	0.19	0.19	0.13
BCS	0.20	0.23	0.23	0.28*
Heart girth	0.04	0.19	0.19	0.13
Stature	0.25*	0.49**	0.49**	0.44*
Chest width	0.02	0.56**	0.56**	0.39*
Wither height	0.36*	0.61**	0.61**	0.59**
Body depth	0.00	0.42*	0.42*	0.25*
Body length	-0.05	0.48**	0.48**	0.26*
Rump width	0.31*	0.61**	0.61**	0.60**

** = P<0.01, * = P<0.05, BW: Body weight, BCS: Body condition score, TC: Testicular circumference, TL: Testicular length, TW: Testicular width, TWT: Testicular weight

Table 5: Correlated relationship between body conformation and semen characteristics in red sokoto bucks

	Volume	Motility	pH	Concentration	Live/dead ratio
BW	0.28*	-0.01	-0.41*	0.01	0.37*
BSC	0.28*	0.02	-0.41*	0.06	0.30*
Heart girth	0.28*	-0.02	-0.41*	0.01	0.39*
Stature	0.48**	0.05	-0.39*	0.05	0.03
Chest width	0.27*	0.08	0.09	0.17	0.07
Wither height	0.36*	0.05	-0.29*	0.07	-0.02
Body depth	0.18	0.06	-0.02	-0.02	-0.01
Body length	0.27*	-0.02	-0.19	-0.05	0.13
Rump width	0.45**	0.08	-0.23	-0.05	0.04

** = P<0.01, * = P<0.05, BW: Body weight, BCS: Body condition score.

Table 6: Correlated relationship between testicular measurements and semen characteristics in red sokoto bucks

	TL	TC	TW	TWT
Volume	0.31*	0.33*	0.33*	0.39*
Motility	0.38*	0.31*	0.31*	0.37*
pH	-0.37*	-0.31*	-0.31*	-0.36*
Concentration	0.31*	0.25*	0.25*	0.32*
Live/dead ratio	0.38*	0.38*	0.38*	0.31*

* = P<0.05, TC: Testicular circunference, TL: Testicular length, TW: Testicular width, TWT: Testicular weight