



Testicular Biometry and its Relationship with Age and Body Weight of Indigenous Bucks (Algeria)

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Abstract | Body weight (BW) and scrotal circumference (SC) were obtained from 50 indigenous bucks (between one and three years old) in the region of El-Tarf (Algeria) to define testicular growth development and their relationship with age. Then, the bucks were slaughtered and the testicles were collected. The testicular sizes (Testicular length (TL), Testicular Diameter (TD) and testicular weight (TW) were measured, the gonadosomatic index (GSI) was calculated. Results revealed that the means of body weight, reaching a value of 28, 53±7.38 kg. These parameters were correlated with one; another and the values were compared with those. The SC was positively correlated with the BW and the TW ($r = 0.74$, $p < 0.001$), the TL ($r = 0.56$, $p < 0.001$), the TD ($r = 0.32$, $p < 0.05$). The GSI showed negative correlation with body weight and testicular weight. Results of the present study revealed that SC and TW are the most reliable useful indicator and are an important selection criterion to determine the testicular development and breeding soundness of bucks as it is highly correlated with testicular parameters.

Keywords | Age, Body weight, Bucks, Testicular measurements, El- tarf.

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INTRODUCTION

Goats are important domestic farm animals in the world as a source of meat, milk and skin (Onakpa et al., 2010). In Algeria, it has been estimated that there are about 4.9 million goats and this population makes it the second most important livestock species (FAO, 2014). They are kept primarily for meat and contribute substantially to household income and food security in most rural areas.

Breeding programmes require assurance of the reproductive capacity of breeders, but in areas with low technical and laboratory support for semen evaluation, farmers may need a reference range of testicular sizes, without extraneous mitigating conditions, which may be associated with adequate sperm reserve for reproductive efficiency. In this study, the testicular biometric parameters; such as scrotal

circumference (SC), testicular weight (TW) and testicular length (TL), of indigenous bucks were evaluated with the aim of identifying bucks with optimal sperm output from testicular and related size variables. Among these parameters are used most often because it's easy to measure and display a high correlation with body weight and reproductive capacity (libido), particularly sperm production (Brito et al. 2004). While their biometric data help define the reproductive parameters for a species should be performed to certify the reproductive capacity of a male (Ohashi et al., 2007). In the male for instance, there is the need to establish measurable criteria for judging breeding soundness and guiding selection of males for breeding, this is why the aim of our study is to determine some reproductive characterization of local buck.

STUDY AREA

This study was conducted at Ain Assel slaughterhouse in the region of El-Tarf which is located in the extreme north east of Algeria, at latitude: 36.7863, Longitude: 8.3824 36° 47' 11" North, 8° 22' 57" East, with an area of 9 480 hectares, a Mediterranean climate with hot summer (Figure 1).

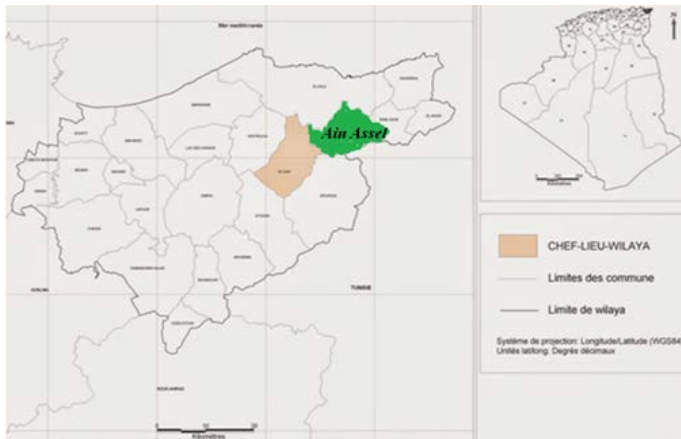


Figure 1: Study Area

STUDIED ANIMALS AND DATA COLLECTION

The 50 indigenous bucks of various ages (between one and three years) taken to slaughter included in this study were confirmed to be on apparent health and free of any gross ante- or post-mortem abnormalities and disorders of the genital organs, during spring between April 8, 2017, and June 14, 2017. The age of the animals was determined by the dentition as described by Desta (2009), counting the number of permanent incisors that have erupted on the lower jaw of the mouth. They were divided into five-age classes: class 1: 12 months, class 2: (12–18) months, class 3: (18–24) months, class 4: (24–30) months and class 5: (30–36) months.

The Body weight (BW, kg) of each animal was recorded before slaughter using a portable balance. The Scrotal circumference (SC, cm) was obtained with a cloth tape. It was measured as the largest diameter of the testes and scrotum after pushing the testes firmly into the scrotum (Goyal and Memon, 2007; Jimenez-Severiano et al., 2010).

Immediately after bucks were slaughtered, the testes of each animal were collected, then testicular parameters including testicular weight (TW, g), testicular diameter (TD, cm), and testicular length (TL, cm) were measured and recorded for each animal according to methods and procedures adopted by Oyeyemi et al. (2012) and Ajao et al. (2014).

Testicular weight (TW, cm) was measured by putting the

testes on a sensitive electronic weighing scale (sensitive to the nearest 0.001g) (Oyeyemi et al., 2012). Testicular Diameter (TD, cm) this was also measured around the widest point at an area that is equidistant to the testicular poles (Ajao et al., 2014). Testicular Length (TL, cm) was measured along the longitudinal axis of the testis beginning from one pole of the testis to the other pole (Toe et al., 2000; Belkhiri et al., 2017). Gonadosomatic index (GSI, g/kg) was estimated as the ratio of each testicular weight to body weight (Abba and Igbokwe, 2015).

STATISTICAL ANALYSIS

Data were analysed using SPSS statistical analysis software (version 19) and expressed as the mean \pm standard error of mean (S.E.M). The effect of age was compared by the Student Newman-Keuls multiple comparison test. The correlation coefficient was used to determine the degree of the linear relationship between body weight and the different testicular measurements.

RESULTS AND DISCUSSIONS

The overall body weight (BW), scrotal circumference (SC), testicular length (TL), testicular weight (TW), and testicular diameter (TD) measurements in all bucks were $28,53 \pm 7,38$ kg, $22,52 \pm 3,61$ cm, $9,19 \pm 1,79$ cm, $71,94 \pm 13,02$ g, $5,78 \pm 1,02$ cm, respectively (Table 1).

The Gonadosomatic index (GSI) which expresses the relationship between total testicular mass and body weight, representing in the current study the mean of $2,59 \pm 0,40$ g/kg. Testicular sizes of animals are important for identification of those with adequate sperm production. Scrotal circumference is measured as it gives a good indication of the male ability. This is an important indicator when observing animals and an essential part of breeding soundness evaluation (Swanepoel and Heyne, 1990; Osasanya et al., 2014; Schoenian, 2012). Moreira et al. (2001) verified in a study of Santa Ines sheep that scrotal circumference can be considered as a viable indicator of the effect of thermal stress on gonads. Akpa et al. (2012) stated that any factor that influences the functioning of the scrotum would invariably affect the reproductive efficiency of the ram. However, it should be noted that scrotal circumference may be greatly decreased by weight loss as well as by the season of the year. For dairy goat breeds weighing more than 40 kg, a scrotal circumference of 25 cm or greater is desired (NseAbasi, 2015).

The value obtained in this study compares favourably with three indigenous breeds of bucks in Ethiopia, reported by Amare and Kefelegn (2017) as a body weight (22.1 ± 2.98 Kg), a scrotal circumference (20.8 ± 1.94 cm), a testis weight (70.0 ± 5.66 g), and a testicular diameter (4.28 ± 0.45 cm), but much higher than the (59.90 ± 16.10) g for

Table 1: Mean and SE of the effect of age on body weight and testicular measurements of indigenous bucks

	All bucks	12	(12–18)	(18- 24)	(24- 30)	(30–36)	p
N	50	13	11	9	8	9	
BW (kg)	28,53 ± 7,38	23,06 ^c ±4,12	24,86 ^{bc} ±5,39	28,02 ^b ±5,75	34,28 ^a ±5,63	36,32 ^a ±6,54	***
SC (cm)	22,52 ± 3,61	18,22 ^c ±1,94	21,79 ^b ±2,20	22,76 ^b ±1,76	25,70 ^a ±2,08	26,56 ^a ±1,35	***
TL (cm)	9,19 ± 1,79	8,02 ^c ±1,07	8,66 ^b ±2,05	9,79 ^{ab} ±1,48	9,63 ^{ab} ±1,22	10,52 ^a ±2,02	**
TD (cm)	5,78± 1,02	5,42±0,80	5,66±0,72	5,87±1,05	6,11±1,15	6,04±1,44	ns
TW (g)	71,94 ± 13,02	60,88 ^d ±6,31	68,37 ^c ±8,14	69,51 ^c ±8,47	78,96 ^b ±11,76	88,45 ^a ±11,13	***
GSI (g/kg)	2,59 ± 0,40	2,70 ^{ab} ±0,43	2,83 ^a ±0,49	2,53 ^{abc} ±0,35	2,31 ^c ±0,17	2,46 ^{bc} ±0,22	*

^{a,b,c}: Means in the same row and with different superscript have significant deference , BW: Body weight, SC: Scrotal circumference, TL: Testicular Length, TD: Testicular Diameter, TW: Testicular weight, GSI: Gonadosomatic index.

Table 2: Coefficient of correlation among morphometric testicular measurements and body weight in indigenous bucks in the region of El-Tarf

	BW (kg)	SC (cm)	TL (cm)	TD (cm)	TW (g)	GSI (g/kg)
BW (kg)	1	0,74***	0,70***	0,49***	0,86***	- 0,71***
SC (cm)		1	0,56***	0,32*	0,74***	-0,43*
TL (cm)			1	0,63***	0,66***	-0,43**
TD (cm)				1	0,36*	-0,40**
TW (g)					1	- 0,26
GSI (g/kg)						1

*Correlation is significant at the 0.05 level. **Correlation is significant at the 0.01 level. ***Correlation is significant at the 0.001 level. BW: Body weight, SC: Scrotal circumference, TL: Testicular Length, TD: Testicular Diameter, TW: Testicular weight, GSI: Gonadosomatic index.

testicular weight (19.07 ± 1.29) cm for the scrotal circumference and for the gonadosomatic index of (3.51 ± 0.69) g/kg of Sahel goats in Maiduguri, Nigeria by [Abba and Igbokwe \(2015\)](#).

Other biometric parameters, testicular weight, which is a reliable index of semen-producing ability has been shown to vary according to breeds, age and time of the season. [Abdou and al. \(1982\)](#) reported that variations in the testes weight are markedly greater between younger bulls and decrease with the advancement of age. Similar reports of differences between breeds were reported in goats ([Raji et al., 2008](#)) and cattle ([Addass, 2011](#)). [Brito et al. \(2004\)](#) have reported that heavier testes produce more spermatozoa than the smaller testes. More so, According to [Söderquist and Hultén \(2006\)](#), males with larger testes tend to sire daughters that reach puberty at an earlier age and ovulate more ova during each oestrus period.

[Table 1](#) shows an increase of the majority of the studied characteristics of goat male, with differences class age from very to highly significant in the spring period. So, the Gonadosomatic index shows variations with significant differences (p< 0.05). Thus, the difference between body weight, scrotal circumference and testicular weight were very significant (p<0.001), while, There is no significant difference (P>0.05) on testicular Diameter. This is expected as there is a linear relationship between body weight,

testicular measurements and age ([Land et al., 1982](#)). [Bilaspuri and Singh \(1993\)](#) reported similar relationships in Malabari and Beetal goats and asserted that such relationship may have a predictive value. [Bongso et al. \(1982\)](#) also reported that testicular measurements increased with age and body weight in Saneen and Jumnapari goats in Malaysia.

An increase in GSI is induced by increase in gonad weight ([Oyeyemi et al., 2009](#)). This indicated a normal structure of the spermatozoa and proved their high capacity for fertilization ([Leal et al., 2004](#)). On the other hand, [Wang et al. \(2015\)](#) suggested that the high GSI values that the testicles have grown which is the period of puberty. [Foc et al. \(2014\)](#) related sexual maturation to age and their location in the maximum period of reproduction. Also, testicular growth is sustained in a period appropriate to the proliferation of seminiferous tubule epithelium associated with an increase in sperm production. Therefore, according to our results of GSI related with age, indicating that testes grow until mature body weight is attained; age of sexual maturity for local goat males is (12–18) months.

The correlation coefficient indicating the relationship between the live weight and testicular measurements are shown in [Table 2](#). With body weight, testicular weight, scrotal circumference and Testicular Length had the highest correlation coefficient (0.86 0.74 and 0, 70), respec-

tively, which were highly significant ($P < 0.001$). Testicular Diameter had high and significant ($P < 0.001$) correlation coefficients indicating a good association with body weight of goats.

Bourn et al. (1994) reported correlation coefficients of 0.70 between SC and body weight in red Sokoto goats which is close to that reported in this study. They were, however, lower than the coefficient of 0.94 reported by Kwari et al. (2004) for Saneen and Jamnapuri crosses. This difference could be due to the effect of genotype or breed. Similar reports of SC being correlated with body weight were observed in bulls (Bitto and Egbunike 2006), rams (Kwari and Ogwuegbu, 1992) and Buffalo (Ogwuegbu et al., 1985).

A significant ($p < 0.05$, $p < 0.001$) and positive correlations exist between the testes weight and all the morphometric characteristics. This observation is very much similar to the report obtained in some domestic animals; goat (Bitto and Egbunike, 2006; Ugwu, 2009), ram (Ahemen and Bitto, 2007), domestic chicken (Orlu and Egbunike, 2010). Similarly, scrotal circumference has been shown to correlate ($p < 0.05$, $p < 0.01$) with testicular weight, Testicular Length and Testicular Diameter. Similar observation was reported by Osinowo et al. (1977), Tegegne et al. (1992) and Ajani et al. (2015).

The good and positive correlations between testes weight, scrotal circumference and morphometric characteristics indicate the sperm-producing capacity of bucks, since it is approved that testes weight is very highly correlated with testicular sperm reserves (Ogwuegbu et al., 1985) and males with larger testes tend to produce more sperm (Okwun et al., 1996). Also Ugwu asserted that a good measurement of the circumference, test length and width would be a reliable predictor of the sperm-producing capacity of bucks. More so, Keith et al. (2009) suggested the use of scrotal size and testicular measurements to select for improved sperm production and breeding males.

It has been reported that measurement of a scrotal circumference, testes length, weight, and width would be a reliable predictor of the sperm-producing capacity of bucks and they can be used to select for improved sperm production and breeding males (Keith and al. 2009; Belkadi et al., 2017). In this study, as a single measurement, testicular weight was more reliable in predicting body weight ($R^2 = 0.86$) while Testicular Diameter was the least predictor ($R^2 = 0.49$), this suggests that combined with other variables testicular weight can be used to select males for testicular size at puberty since it is a reliable variable for estimating the sperm production capacity but it varies depending on the breed (Ibrahim et al., 2012). In order that weight could be estimated more accurately by combination

of two or more measurements (Mohammed and Kibon, 2003; Thiruvankanden, 2005) made similar observations in their studies.

The strong Correlations negative between Gonadosomatic index and body weight ($r = -0.71$), justifies the dependence of this one. However, which is explained by the fact that GSI do not always evolve in the same direction as that of body weight, there was a lack of remarkable dependence of GSI on testicular weight ($r = -0.26$) and related size variables among the goats ($r = -0.43$, $r = -0.40$ and $r = -0.43$) on testicular length, testicular diameter and scrotal circumference, respectively.

Also, Belkhiri et al. (2017), proved in their study on Ouled Djellal lambs from birth to puberty that GSI is highly correlated with testicular weight ($= 0.99$), testicular length ($= 0.96$), body weight ($= 0.84$) and scrotal circumference ($= 0.79$).

Abba and Igbokwe (2015), reported that body weight did not correlate ($r = 0.15-0.27$) significantly with GSI, but GSI correlated with testicular weight as well as scrotal circumference. In this study were expected to have adequate the testes of goats grow until body weight is attained at >12 months, if the testicular sizes were appropriate. As the bucks got older up to 12 months of age, the testicular weight was increased because the bucks had increasing body weight and testicular size (Mshelbwala, 2010).

The findings of this study could be used in breeding soundness assessment to select fertile bucks in their natural environments. Availability of field information on the scrotal circumference and morphometric testicular sizes would be implicated as an important factor in male reproductive success at predicting the testicular potentials of the indigenous bucks of El Tarf. This would increase the breeding efficiency, save costs and prevent loss of reproductive time.

In conclusion, this study shows that there is a positive correlation between morphometric testicular measurements (SC, TL, TW, TD) and body weight; correlation which tends to increase significantly with age. We can conclude that the testicular morpho-biometry, closely related to body weight is as important to the evaluation of the reproductive ability of males to be selected. Thus, it is therefore recommended that the age, weight and scrotal circumference of animals should be part of breeding soundness examination.

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None of the authors have any conflict of interest to declare.

AUTHORS CONTRIBUTION

All authors have been involved in constructing the experimental design, analysing data and preparing.

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