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Testicular Morphometric Measurements of Ouled Djellal Lambs from Birth to Puberty

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Abstact: Measurement of body weight and testicular parameters is an essential part of breeding soundness evaluation of breeding rams.The aim of this study was to define testicular growth development of Ouled Djellal lamb and the relationship between the testicular morphometrics with age. Sixteen OuledDjellal male lambs were divided to eight age groups from 1to 8 months age, keeping 2 lambs in each group. Results revealed significant differences ($P < 0.001$) in testis size, scrotal parameters and gonadosomatic index (GSI) of lambs between all ages (1–8 months), which explained the nonlinear relationship between these parameters and age. A similar trend of growth was observed for the mean body weight, reaching a maximum value of 43.80 ± 0.48 kg at the age of 8 months. The scrotal circumference was highly correlated with testicular parameters and body weight compared to age. The gonadosomatic index showed positive correlation with body weight and testicular weight. Results of the present study revealed that scrotal circumference is a useful indicator and is an important selection criterion to determine the testicular development and breeding soundness of OD lambs as it is highly correlated with testicular parameters.

Key word: Testicular Morphometrics · Age · Body weight · Ouled Djellal Lambs

INTRODUCTION

Growth, one of the most essential traits for farm animals, is defined as an increase in tissues and organs of the animals per unit time and is affected by genetic and environmental factors. The growth that has sigmoid form is explained reliably by nonlinear growth models [1] and it's influenced by genetic and environmental factors.

Testicular biometric parameters at early ages were very useful in selection of breeding sires to collect semen for artificial insemination or breeding purpose. The knowledge of testicular development in rams is of a great importance for determining number of spermatozoa and volume of ejaculate.

Testis size is a standard of fertility and reproductive ability of the ram, as the amount of testicular mass correlated with the sperm production ability [2] and also it may be useful as a selection criterion for improving reproductive capacity in both sexes.

The males with bigger testes produce more sperm than the males with smaller testes. Increasing age and body weight correlated positively with testicular sizes of lambs [3]. These are the potentially useful indicators of reproductive traits and have been used to compose selection indices for rams to use in breeding purpose. These traits are easily measured and correlated with body weight and reproductive performance.

The purpose of this investigation was to measure the development of several testicular and scrotal characteristics and relationship between testicular parameters and body growth in growing lambs.

MATERIALS AND METHODS

Animals and Location: The study was carried out at Khebbaba farm of Mezloug (Setif), Algeria. Mezloug is about 10 kilometers to the South East of Setif, at latitude 36° 6' 28 North and longitude 5° 20'13 East at mean altitude

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of 933 meters above sea level. Sixteen Ouled Djellal (O.D.) lambs born in autumn (October 2013) were equally divided into eight age groups of 1to 8 months of age.

Data Collection: The body weight (BW) was measured using electronic weighing balance and recorded in kilograms (kg). Scrotal width (SW),testis width (Tl) and testis thickness (TT): This was also measured around the widest point at an area that is equidistant to the testicular poles [4].

Testicular plus Epididymal length (TL) was measured along the longitudinal axis of the testis beginning from one pole of the testis to the other pole [5].The scrotal circumference (SC) was measured at the widest point that is equidistant from the scrotal poles using a non-stretchable measuring tape [6].

The testes were immediately collected after castration. Testicular weight (TW) was measured by putting the testes on a sensitive electronic weighing scale (sensitive to the nearest 0.001g). Gonadosomatic index (%) was calculated using the equation: GSI = [testis weight/body weight] x 100 [7].

Statistical Analyses: Data were analyzed using SPSS 21 (SPSS, 2013) and expressed as the mean ± standard error of mean (S.E.M). Simple one way ANOVA was used to study the effect of age on testicular morphometric parameters and Duncans Multiple range test was used to differentiate between significant means. Differences with values of < 0.05 were considered to be statistically signifiant. The Pearson's correlation coefficients were used to assess the association between the parameters studies. The regression equations employed were:

$Y= b_0 + b_1X$ (linear model)
$Y= = b_0+ b_1 X + b_2 X^2$ (quadratic model)
$Y= b_0 + b_1 X+ b_2 X^2 + b_3 X^3$(cubic model)
$Y= b_0 e^{b1x}$ (exponential model)
$Y= b_0 X^{b1}$ (Power Model)
Y = dependent variables
b0 = the intercept
X = independent variables
b_1, b_2 and b_3 = regression coefficients
e = random error.

RESULTS

The results of different testicular parameters, scrotal width, scrotal circumference, GSI and body weight at different ages of O.D. lambs were presented in Figure 1 to 8.

Body Weight (BW): From Figure (1), BW is expressed graphically and the results showed a third-order polynomial (cubic) relation between BW and age ($Y=-1,514+11,823x - 1,311 x^2+ 0,066x^3$). By a semi-logarithmic representation, two straight lines of different slopes intersected with body weight of 29.80 kg, which is equivalent to 4 months of age. BW increased significantly ($P < 0.001$) with increasing age from 1to 8 months (Table 1).

Testis Weight (TW): Results showed a third-order polynomial (cubic) relation (Figure 2) between the testis weight and age ($Y= 16,343-18,221x+5,249x^2-0,206x^3$). By a semi-logarithmic representation, two straight lines of different slopes intersected with a weight of testicle of 15.80 g, which is equivalent to

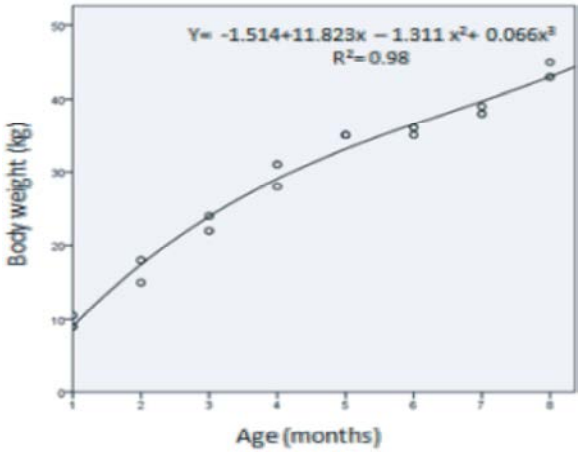

Fig. 1: Relationship between body weight and age in O.D. lambs.

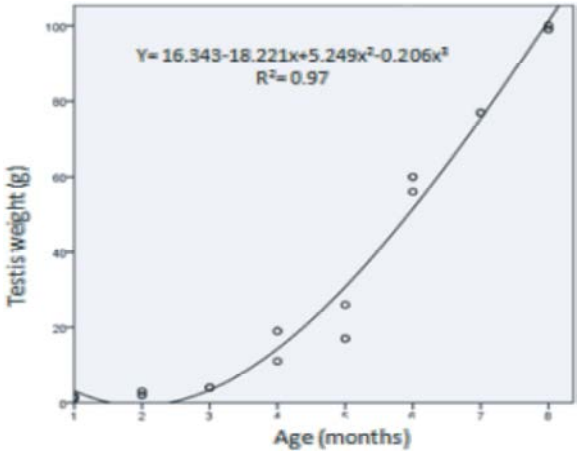

Fig. 2: Relationship between testis weight and age in O.D. lambs.

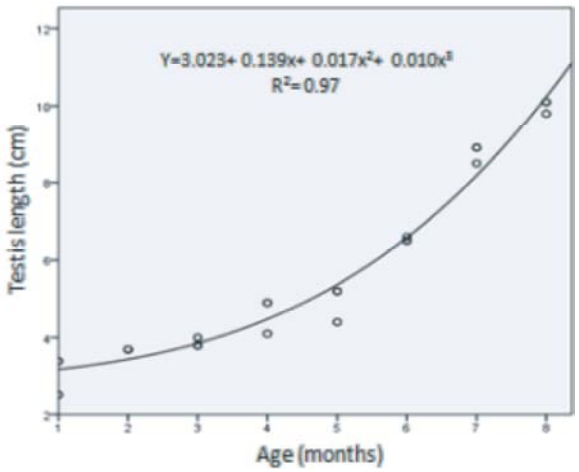

Fig. 3: Relationship between testicular plus epididymal length and age in O.D. lambs.

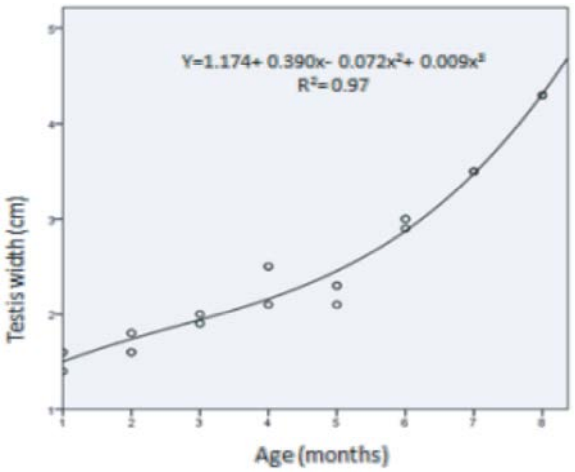

Fig. 4: Relationship between testis width and age in O.D. lambs.

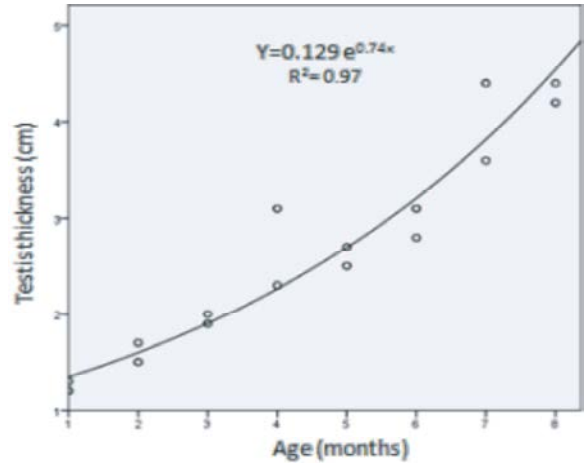

Fig. 5: Relationship between testis thickness and age in O.D. lambs.

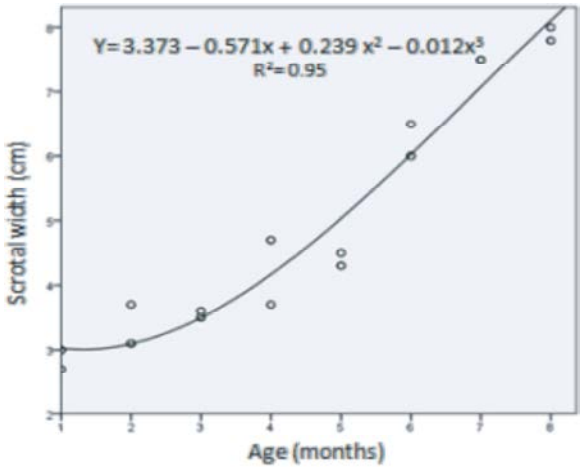

Fig. 6: Relationship between scrotal width and age in O.D. lambs.

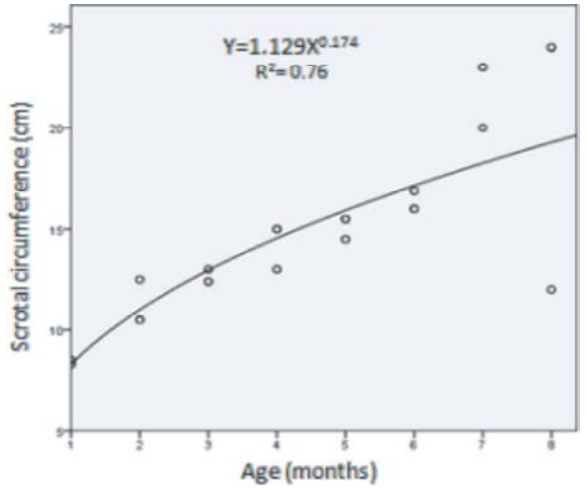

Fig. 7: Relationship between scrotal circumference and age in O.D. lambs.

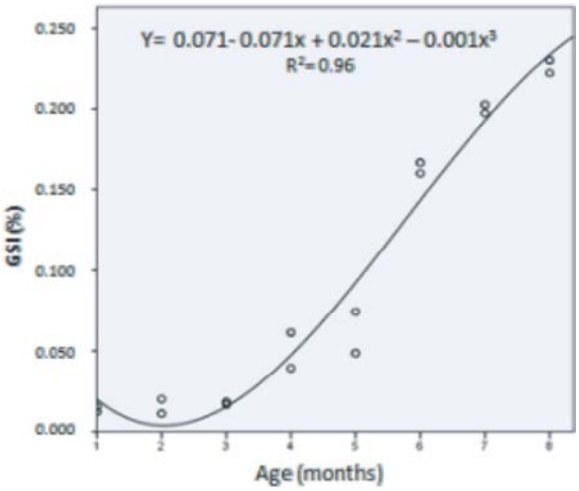

Fig. 8: Relationship between GSI and age in O.D. lambs.

Table 1: Body weight and morphometric testicular in OD ram lambs (Mean ± SEM)during 1–8 months of age.

Age (months)	1	2	3	4	5	6	7	8	p
BW(kg)	9.60±0.36	16.8±0.73	22.80±0.48	29.80±0.73	35.00±0.00	35.60±0.24	38.40±0.24	43.80±0.48	***
TW(g)	1.30±0.12	2.40±0.24	4.00±0.00	15.80±1.95	20.60±2.20	58.40±0.97	77.00±0.00	99.40±0.24	***
LT(cm)	3.04±0.22	3.70±0.00	3.88±0.04	4.58±0.19	4.88±0.19	6.54±0.02	8.74±0.09	9.98±0.07	***
lT(cm)	1.52±0.04	1.68±0.04	1.94±0.02	2.34±0.09	2.22±0.04	2.96±0.02	3.50±0.00	4.30±0.00	***
TT(cm)	1.24±0.02	1.58±0.04	1.94±0.02	2.78±0.19	2.58±0.04	2.98±0.07	4.08±.019	4.28±0.04	***
SW (cm)	2.88±0.07	3.34±0.14	3.54±0.02	4.30±0.24	4.38±0.04	6.20±0.12	7.50±0.00	7.88±0.04	***
SC(cm)	8.42±0.04	11.3±0.48	12.64±0.14	14.20±0.48	15.10±0.24	16.36±0.22	21.80±0.73	19.20±2.93	***
GSI(%)	0.01±0.00	0.01±0.00	0.13±0.00	0.16±0.00	0.17±0.01	0.21±0.01	0.50±0.00	0.50±0.00	***

BW (body weight); TW (testicular weight); TL (testicular plus epididymal length); Tl (testicular width); TT (testicular thickness); SW (scrotal width), SC (scrotal circumference); GSI (gonadosomatic index), *** Significant at P <0.001.

Table 2: Coefficient of correlation among morphometric testicular and body weight in O.D. ram lambs during 1–8 months of age

r	Age (months)	BW (kg)	TW (g)	TL (cm)	Tl(cm)	TT(cm)	SW(cm)	SC(cm)	GSI (%)
Age (months)	1								
BW (kg)	0.97***	1							
TW (g)	0.93***	0.84***	1						
TL (cm)	0.94***	0.86***	0.98***	1					
Tl (cm)	0.95***	0.88***	0.97***	0.98***	1				
TT (cm)	0.95***	0.92***	0.92***	0.94***	0.95***	1			
SW (cm)	0.95***	0.87***	0.98***	0.98***	0.97***	0.95***	1		
SC (cm)	0.83***	0.78***	0.77***	0.82***	0.79***	0.83***	0.82***	1	
GSI (%)	0.93***	0.84***	0.99***	0.96***	0.96***	0.92***	0.98***	0.79***	1

BW (body weight); TW (testicular weight); TL (testicular plus epididymal length); Tl (testicular width); TT (testicular thickness); SW (scrotal width), SC (scrotal circumference); GSI (gonadosomatic index), *** Significant at P <0.001.

4 months of age. TW significantly ($P < 0.001$) increased with increasing age from 1 to 8 months (Table 1).

Testis plus Epididymis Length (TL): Testis length increased from 3.04 ± 0.22 cm at 1 month old and reached 9.98 ± 0.07 cm at 8 months. The increase of testis plus epididymis length in lambs (Figure 3) is described by the third-order polynomial (cubic) relation with age ($Y=3,023+ 0,139x+ 0,017x^2+ 0,010x^3$).

Testis Width (Tl): The mean Tl evolves according to to third-order polynomial (cubic) relation ($Y=1,174+ 0,390x- 0,072x^2+ 0,009x^3$) between the Tl and age. Mean Tl increased from 1st month of age (1.52 ± 0.04cm) reaching a maximum value of 4.3 ± 0.00 cm at the age of 8 months. Tl significantly increased ($P < 0.001$) from 1 to 8 months old lambs (Figure 4).

Testis Thickness (TT): TT increased significantly ($P < 0.001$) from 1.24 ± 0.02 cm at one month old and reached a 4.28 ± 0.04 cm at the age of 8 months (Table 1). The equation (Figure 5) estimated from the regression of testis thickness and age: $Y=0,129\ e^{0,74}$ (where Y = TT and X = age).

Scrotal Width (SW): The mean SW (Figure 6) evolves according to third-order polynomial (cubic) relation age ($Y= 3,373 – 0,571x + 0,239\ x^2 – 0,012x^3$) (where Y = SW and X = age). Mean SW increased from 1st month of age (2.88 ± 0.07 cm) reaching its maximum (7.88 ± 0.04 cm) at the age of 8 months. Sl significantly ($P < 0.001$) increased with increasing age from1 to 8 months (Table 1).

Scrotal Circumference (SC): The mean SC evolves according to power relation ($Y=1,129X^{0,174}$) with age (Figure 7). SC mean increased significantly($P < 0.001$) from 1st month of age (8.42 ± 0.04 cm) reaching its maximum (19.20 ± 2.93 cm) at the age of 8 months (Table 1).

Gonadosomatic Index (GSI): The GSI (Figure 8) expresses the relationship between total testicular mass and body weight, representing the percentage of body mass allocated in the testicles. The GSI, among animals under the current study, ranged from 0.01 to 0.22% between one and eight months. The equation estimated from the regression of GSI and age was $Y= 0,071- 0,071x + 0,021x^2 – 0,001x^3$ (where Y = GSI and X = age). The estimated regression equation showed high coefficient of determination ($R^2 = 0.96$).

Correlation: Correlations coefficients (Table 2) showed that various measurements of the testis correlated with each other ($P < 0.001$),body weight and age. Body weight correlated significantly with all testicular measurements. Moreover, body weight strongly correlated with scrotal circumference (r =0.78; $P< 0.001$). While the testicular weight correlated with testicular plus epididymal length (r = 0.98, $P <0.001$), testicular width (r = 0.97, $P <0.001$) and testicular thickness (r = 0.92, $P <0.001$). The testicular plus epididymal length correlated (r = 0.98, $P<0.001$) with testicular thickness.

The scrotal circumference correlated highly with TW (r = 0.77, $P < 0.001$) and the TL (r = 0.82, $P <0.001$). GSI correlated with TW (= 0.99), TL (= 0.96), Tl (= 0.96), TT (= 0.92), SW (= 0.98), BW (= 0.84) and SC (= 0.79).

DISCUSSION

Results of this work showed that body growth curve of the lambs has a segmoid appearance Similar to that reported for Awassi lambs [2]. in contrast, Tanyang lambs body growth in China between 3 and 8 months was linear [8]. The BW of one month old of O.D. lambs (9.6 kg) of our study was higher (7.86 kg) compared to other study of the same breed [9]. The body weight of lambs of our O.D. breed at 2 months of age is also higher than that of the D'Man breed (16,80 ± 0,73 kg vs 10,7 ± 0,3 kg respectively). This superiority is also remarkable in the third, fourth and fifth months between these two breeds [10]. In the 8th month, the live weight of the lambs (43.8 kg) is much higher (37.4 kg) than that reported for the Najdi breeds [11]. These differences could be referred to the seasonality of reproduction and that the lambing season is very important in the development of the body [12].

Testicular development in O.D. lambs follows a sigmoid curve with two distinct phases and is more closely associated with body weight than with age. This is in agreement with the observation reported by Tariq *et al.* [1]. The values of testicular measurements in this study are comparable to those of the Kirvircik breed [13] and Awassi [14] with some differences that appear to be due to the effects of the different environments in which the rams were raised [15] and the breed [16]. The postnatal growth of the testes is as a result of the increase in both the length of the seminiferous tubules and the intertubular tissue [17]. Thus, Focşăneanu *et al.* [18] related sexual maturation with age of rams 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.

The increase in GSI is induced by the increase in gonad weight [19]. This indicated a normal structure of the spermatozoa and proved their high capacity for fertilization [20]. On the other hand,Wang *et al.* [21] suggested that the high GSI values that the testicles have grown which is the period of puberty.

In the present study, the various measurements of testis size were highly correlated with each other. All correlation coefficients were highly significant ($p<0.001$). These results were in agreement with those reported by Sahlab *et al.* [2].

The results of our study revealed that scrotal circumference of O.D lambs highly correlated with other testicular parameters. Similar findings also reported by many authors [19, 22]. The correlation between scrotal circumference and testis weight is similar to the values reported by Boussena *et al.* [9] and Maksimović *et al.* [23].

Similarly, Boussena *et al.* [9] reported that testicular growth correlated with both body weight and age. Salhab *et al.* [2] and Rege *et al.* [24] reported that the various testicular measurements correlated with body weight of growing lambs than age. Contrary tour results, Murta *et al.* [25] reported a negative relationship between body weight and testes weight (r = -0.96). While other found no correlation between these parameters in some species of mammals [26].

Morphometric testicular has been implicated as an important factor in male reproductive success because larger testes produce higher quality ejaculates and have higher rates of sperm production [3].

CONCLUSION

The present study revealed that interrelationships between scrotal size parameters (SC, SW), testicular size parameters (TW, TL, Tl and TT) and BW of Ouled Djellal lambs were positive, strong and highly significant. These findings, especially of the prediction models developed, could be useful in the management and selection of rams for breeding purposes. The measurement of scrotal circumference in O.D. lambs is very useful to predict the testicular parameters and can be used in breeding centre to select suitable breeding male for artificial breeding purpose.

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