Development of testicular dimensions and size, and their relationship to age and body weight in growing Kivircik (Western Thrace) ram lambs

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ABSTRACT: Forty-seven Kivircik ram lambs, aged 2 months, raised and managed under an intensive system were used to measure the development of testis diameter and length, and scrotum circumference, length and volume, and their association with the development of body growth. The effects of age and body weight of lambs, type of birth and dam age on the development of the five testicular parameters from weaning at 2–6 months of age were investigated. In ram lambs, the respective least-squares means of testis measurements: testis diameter, testis length, scrotum circumference, scrotum length and scrotum volume were 2.55 ± 0.099 cm, 5.83 ± 0.165 cm, 15.23 ± 0.650 cm, 7.24 ± 0.287 cm and 87.57 ± 5.921 cm^3 at 2 months; and 2.99 ± 0.099 cm, 6.59 ± 0.164 cm, 14.24 ± 0.657 cm, 10.60 ± 0.290 cm and 157.49 ± 5.987 cm^3 at 6 months. The effect of birth type on testis diameter and the effect of dam age on testis length were significant ($P < 0.05$ and $P < 0.01$), besides the effects of lamb age and live weight of lambs on the whole testis measurements were significant ($P < 0.01$).

Keywords: Kivircik lamb; testimetrical parameters; environmental effects

Natural and economic conditions, agricultural characteristics, pasture areas and traditions create suitable conditions for sheep breeding in Turkey. Kivircik is the main native sheep breed of Thrace and Marmara region. It has the thin tail and short ears and produces meat, wool and milk. The live weight of Kivircik ewe is 35–40 kg while ram weight amounts to 45–50 kg (Kaymakci and Sönmez, 1996).

In the Western parts of Turkey, especially in Thrace, sheep milk is mostly used for making a special kind of white cheese which is very popular in Turkey. Most of the lambs are weaned as early as at one and a half months of age, so that ewes can be milked longer and the majority of the lambs are slaughtered without further fattening. In this way, meat production potential of these lambs is poorly utilized. The quality of Kivircik meat is considered to be the best among local and imported breeds as it has a good marbling. Besides Turkey, Kivircik sheep breed is also kept in Bulgaria and Greece especially in Western Thrace parts and is called Thraki sheep (Yalcin, 1986).

Selection for fertility in sheep can be accomplished through selecting for correlated characters in young rams such as testis size (Land and Carr, 1975). After observing testis growth, and small but consistent differences in the development of sexual activity and of sperm production, Louda et al. (1981) also suggested that young rams of prolific breeds (Romanov and Finnish Landrace) might differ in their potential reproductive performance, though slightly.

In general, sexual development of ram lamb appears to be more closely associated with body growth than with chronological age (Dyrmundsson and Lees, 1972). Dyrmundsson (1973) concluded that body weight was a better criterion for the attainment of puberty than the chronological age alone.

The purpose of this investigation was to measure the development of several testicular characteristics, factors influencing them, and relationship of testicular parameters to body growth in growing ram lambs.

MATERIAL AND METHODS

The study was conducted on the Agricultural Faculty Research Farm of Uludag University in Bursa province, Turkey. This farm is located in the humid lowland tropics, at an altitude of 100 m above sea level and at a longitude 29°E and latitude 40°N (average minimum temperature 9.0°C, average maximum temperature 20.2°C, annual rainfall 713.1 mm).

A total of 47 2-month-old Kivircik ram lambs were used. The lambs were weaned at 60 days of age and were housed together in a shed. They were raised under the same management and nutrition conditions. Lambs received 300 g of concentrates containing wheat (75%), sunflower oil cake (23%), limestone (1.4%), salt (0.5%) and premix (0.1%). In addition, the animals were allowed to graze on a good quality pasture. Water was provided *ad libitum*.

When the animals were 2 months old, testis diameter and length and the circumference, length and volume of scrotum and body weights were measured monthly for 4 months (June–October). Testis measurements were obtained via a technique reported by Sönmez and Kaymakci (1987). Briefly, ram lambs were held in a position in which fore legs were up. The length and diameter of testis were measured with a calliper. The scrotum circumference and length were measured with a flexible cloth tape. The volume of the scrotum was evaluated from the volume of water they replaced.

Data from the trails were analysed according to the general linear model (GLM) procedures using Minitab (1998). The factors included in the model as sources of variation were: ram age, age of lamb, type of birth and weight at each measurement. Coefficients of correlation and determination between testicular measurements and ram age and body weight were estimated. Regression equations between the above factors were calculated (Düzgüneş et al., 1983).

The statistical model used in the analysis was as follows:

$$Y_{ijkl} = \mu + a_i + c_j + d_k + bX_{ijkl} + e_{ijkl}$$

where: μ = the overall mean
a_i = the effect of ith age (i = 2, 3, 4, 5, 6)
c_j = the effect of jth ram age (j = 2, 3, 4)
d_k = the effect of kth type of birth
b = the partial regression coefficient of testis or scrotum measure on live weight
X_{ijkl} = the live weight at each measurement
e_{ijkl} = the random error

RESULTS

The least-squares means and standard errors of testis and scrotum traits for type of birth, dam age and different age periods are shown in Table 1. The effect of birth type on testis diameter and the effect of dam age on testis length were significant ($P < 0.05$ and $P < 0.01$), besides the effects of lamb age and live weight of lambs on the whole testis measurements were significant ($P < 0.01$).

The development of the testis diameter and length and the scrotal circumference, length and volume are presented in Figures 1–3.

There was a gradual and linear increase in testicular and scrotal dimensions from 2 to 6 months age. However, as a result of the loss of increase rate from 5 to 6 months a slight decrease in testis diameter, scrotum circumference and scrotum length was noticed. A rapid increase in scrotum volume from 5 to 6 months of age was determined. The increase in testis diameter, testis length, scrotum circumference and scrotum length between 2 and

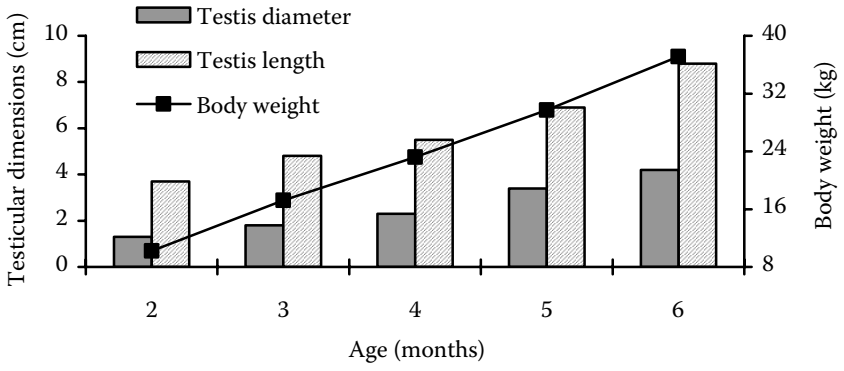
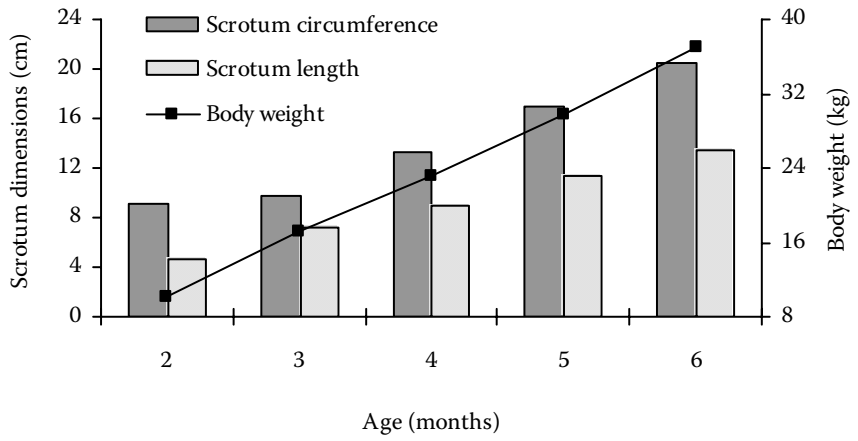


Figure 1. Development of testicular dimensions and body weight in Kivircik ram lambs from 2 to 6 months of age

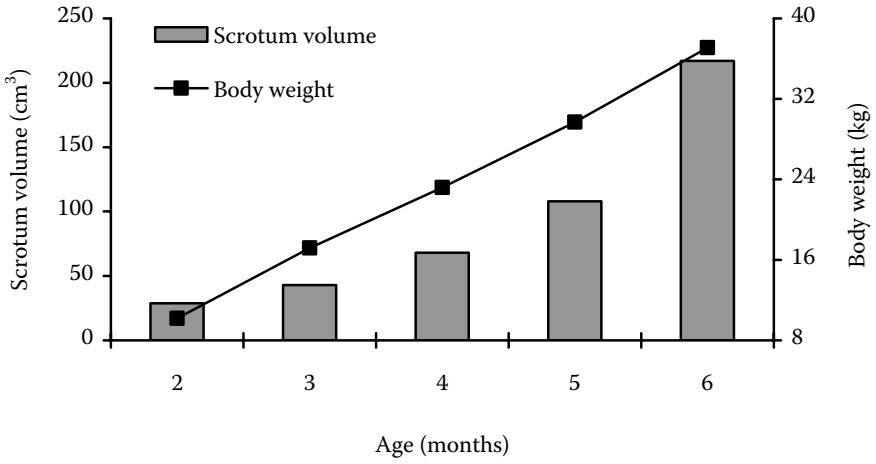
Table 1. Least-squares means and standard errors of birth type, ram age and age period

Parameters		*n*	Testis diameter		Testis length		Scrotum circumference		Scrotum length		Scrotum volume	
			$\bar{x} \pm S_{\bar{x}}$	a.i.	$\bar{x} \pm S_{\bar{x}}$	a.i.	$\bar{x} \pm S_{\bar{x}}$	a.i.	$\bar{x} \pm S_{\bar{x}}$	a.i.	$\bar{x} \pm S_{\bar{x}}$	a.i.
Type of birth			*		ns		ns		ns		ns	
	Single	140	2.54 ± 0.040[a]	–0.07	5.85 ± 0.067	–0.09	14.12 ± 0.265	0.20	9.06 ± 0.117	–0.01	89.90 ± 2.410	–3.26
	Multiple	95	2.68 ± 0.047[b]	0.07	6.03 ± 0.078	0.09	13.72 ± 0.308	–0.20	9.08 ± 0.136	0.01	96.42 ± 2.809	3.26
Ram age (year)			ns		**		ns		ns		ns	
	2	105	2.62 ± 0.046	0.01	5.99 ± 0.076[a]	0.05	13.69 ± 0.300	–0.23	9.02 ± 0.132	–0.05	95.65 ± 2.733	2.49
	3	55	2.50 ± 0.062	–0.11	5.70 ± 0.103[b]	–0.24	13.50 ± 0.407	–0.42	8.86 ± 0.179	–0.21	91.42 ± 3.701	–1.74
	4	75	2.71 ± 0.054	0.10	6.13 ± 0.087[a]	0.19	14.57 ± 0.350	0.65	9.33 ± 0.155	0.26	92.41 ± 3.191	0.75
Age (month)			**		**		**		**		**	
	2	47	2.55 ± 0.099[a]	–0.06	5.83 ± 0.165[a]	–0.11	15.23 ± 0.650[a]	1.31	7.24 ± 0.287[a]	–1.83	87.57 ± 5.921[a]	–5.59
	3	47	2.34 ± 0.076[a]	–0.27	5.81 ± 0.126[a]	–0.13	12.62 ± 0.495[b]	–1.30	8.44 ± 0.218[b]	–0.63	70.71 ± 4.508[b]	–22.45
	4	47	2.36 ± 0.067[a]	–0.25	5.52 ± 0.112[a]	–0.42	13.41 ± 0.441[b]	–0.51	8.95 ± 0.194[b]	–0.12	69.44 ± 4.011[b]	–23.72
	5	47	2.81 ± 0.075[b]	0.20	5.93 ± 0.124[a]	0.01	14.10 ± 0.492[ab]	0.18	10.12 ± 0.217[c]	1.05	80.59 ± 4.479[ab]	–12.57
	6	47	2.99 ± 0.099[b]	0.38	6.59 ± 0.164[b]	0.65	14.24 ± 0.657[ab]	0.32	10.60 ± 0.290[c]	1.53	157.49 ± 5.987[c]	64.33
Body weight (*b*) ($P < 0.01$)				0.090		0.159		0.456		0.202		4.406
Overall		235	2.61 ± 0.031		5.94 ± 0.052		13.92 ± 0.206		9.07 ± 0.090		93.16 ± 1.855	

*$P < 0.05$; **$P < 0.01$; ns = not significant; a.i. = amount of active ingredient



Figures 2. Development of scrotum dimensions and body weight in Kivircik ram lambs from 2 to 6 months of age



Figures 3. Development of scrotum volume and body weight in Kivircik ram lambs from 2 to 6 months of age

6 months of age was low (220–320%) compared to the development of body weight (360%). However, the increase in scrotum volume was twice greater (750%) than the growth of body weight.

Correlations between the testicular and scrotal measurements and the factors affecting testicular and scrotal development were shown (Table 2). As it was expected, the various measurements of testis

Table 2. Coefficients of correlation between testicular, scrotal and influencing factors in growing Kivircik male lambs**

Measurement	Age	Body weight	Testis diameter	Testis length	Scrotum circumference	Scrotum length
Body weight	0.861	–	–	–	–	–
Testis diameter	0.828	0.919	–	–	–	–
Testis length	0.818	0.923	0.953	–	–	–
Scrotum circumference	0.722	0.845	0.889	0.882	–	–
Scrotum length	0.872	0.913	0.918	0.920	0.842	–
Scrotum volume	0.814	0.868	0.897	0.900	0.806	0.863

**all coefficients are statistically significant ($P < 0.01$)

Table 3. Coefficients of determination (R^2) and regression equations for testicular and scrotal development and effective variables in Kivircik male lambs

Parameter	Regression equations	R^2
Testis diameter	–0.551 + 0.126 age + 0.919 body weight	0.850**
Testis length	1.54 + 0.135 age + 0.165 body weight	0.854**
Scrotum circumference	3.46 – 0.076 age + 0.460 body weight	0.713**
Scrotum length	0.963 + 0.825 age + 0.205 body weight	0.862**
Scrotum volume	–69.9 + 13.9 age + 4.57 body weight	0.771**

**$P < 0.01$

were correlated positively and significantly ($P < 0.01$) with each other (Table 2).

Regression equations between testicular and scrotal measurements, age and body weight together with estimates of coefficients of determination are presented in Table 3. All listed characteristics confirm the existence of linear relationships between testicular and scrotal measurements and body weight when age is taken as constant ($P < 0.01$).

DISCUSSION

In this research we determined some testis characteristics of Kivircik ram lambs within a 6-month period. Moreover, the effect of some continual and crucial environmental factors on the testis characteristics was researched. The trend of testicular and scrotal development noticed in this study was similar to that described by Ghannam et al. (1977) in Awassi lambs, Schoeman and Combrink (1987) in Dorper, Dohne Merino and Meat Master lambs and Aygün and Karaca (1995) in Karakaş lambs. Testis diameter generally increased until about 34 weeks of age and showed seasonal variations thereafter in Suffolk lambs recorded by Moore and Sanford (1985). Barwick et al. (1985) determined that the mean testis diameter in Border Leicester inactive rams was smaller than in active rams. In another research sires influenced the testis diameter of the progeny, and effects of sires showed seasonal variations. Sires also influenced the percentage of abnormal spermatozoa, but the effect was lower than that on the testis diameter (Colas et al., 1990).

Age and body weight of Kivircik ram lambs were positively correlated with the five testis measurements ($r = 0.722 – 0.953$, $P < 0.01$, Table 2). However, body weight was more closely correlated with testis measurements than age. Similarly, Kritzinger et al. (1984), Zeng and Lu (1987), Öztürk et al. (1996) and Salhab et al. (2001) reported high significant correlations between body weight and testis parameters.

Testicular and scrotal parameters were positively correlated with each other ($r = 0.806 – 0.953$, $P < 0.01$). Testis length could provide a useful estimate of testicular growth since its correlations with the other testicular measurements were the highest. These results were in agreement with the findings of Land and Carr (1975), Kumi-Diaha et al. (1985), Kaymakci et al. (1988), Foster et al. (1989), Koyuncu et al. (2000) and Salhab et al. (2001). Regression equations presented in Table 3 describe the relationship between testicular and scrotal dimensions (cm) or volume (cm^3) and the age (month) as well as the body weight (kg) of ram lambs. These equations revealed that testis measurements showed a positive relationship with body weight and age of ram lambs. There results are in agreement with the findings of Kaymakci et al. (1988), Mukasa-Mugerva and Azaz (1992), Koyuncu et al. (2000) and Salhab et al. (2001).

The results of this study lead us to postulate that the suitability of testicular and scrotal measurements as criteria for early selection of ram lambs was emphasised. On the other hand, the selection of breeding rams based only on scrotal and testicular measurements is not sufficient. Further studies on testosterone and spermatogenetic activity are needed to confirm the present results.

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