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TESTICULAR DEVELOPMENT AND BODY GROWTH IN PREPUBERTAL RAM LAMBS OF KIVIRCIK, KARACABEY MERINO AND TAHIROVA IN SOUTH MARMARA REGION OF TURKEY

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Abstract

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An experiment was conducted to compare testicular diameter (TD), testicular length (TL), scrotal circumference (SC), scrotal length (SL) and body weight (BW) gain of 150 ram lambs 50 from each of breed. Measurements were taken at 90, 120, 150 and 180 days of age. Breed was significant (P<0.05) all of testicular measurements, except testicular diameter at 90 days of age and testicular length at 120 days of age. The various measurements of testis were correlated positively and significantly (P<0.01) with each other. All characteristics confirm the existence of linear relationship between testicular measurements and body weight when age is taken is constant (P<0.01).

Key words: Ram lambs; testicular measurements; body weight; Kivircik, Karacabey Merino; Tahirova

Introduction

Improvement of sheep productivity requires effective actions on its various components, with prolificacy being one of the most important. The biometrical analysis of testicular development is of great importance since it is significantly correlated with reproductive activity (El-Wishy and El-Sawaf, 1971). 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, Lauda et al. (1981) also suggested that young rams of prolific breeds (Romonov 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).

The purpose of this investigation was to determine the development of the several testicular characteristic, factors influencing them, and relationship of testicular parameters to body growth in three breeds of growing lambs (Kivircik, Karacabey Merino and Tahirova).

Materials and Methods

The study was conducted Karacabey State Farm in Bursa, Turkey. This farm is located in humid lowland tropics, at altitude of 10 m above sea level and at a longitude 28.3° E and latitude 40.2° N (average minimum tempature -15°C, average maximum temperature 38.5°C, annual rain fall 562.0 mm).

The study involved three sheep breeds, the Kivircik (K), the Karacabey Merino (KM) and the Tahirova (T). The main sheep breed of Thrace and Marmara region is the Kivircik (Kaymakcı and Sonmez, 1986). Mutton Merino brought to Karacabey State Farm in 1934, were

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crossed with Kivircik sheep on this farm. At Karacabey State Farm careful selection was also applied, and as a result a new Merino type, Karacabey Merino was developed. It contains about 95% German Mutton Merino and 5% Kivircik genotype (Yalcin, 1986). Tahirova has been obtained by crossbreeding between East Fresian and Kivircik genotypes. This type contains 75% East Fresian and 25% Kivircik genotypes.

Measurements were taken on 150 ram lambs 50 from each of K, KM and T. The lambs were weaned of 90 days of age and were housed together in a shed. After weaning they were penned as a separate group. The animals grazed on natural pastures from 90 to 180 days of age. They were raised under the same management and nutrition conditions. Measurements of body weight (BW), testicular diameter (TD), testicular length (TL), scrotal length (SL) and scrotal circumference (SC) were taken at 90, 120, 150 and 180 days of age. TL (cm) was measured with a caliper on both the left and right testicles, was the distance between the top of the tail and the head of the epididymis. TD (cm) was measured with a caliper on the left and right testicles as the widest anteroposterior diameter. SC (cm) measurement was obtained while the ram was in a standing position and by pushing the testicles to the bottom of the scrotum, then measuring the greatest circumference with a flexible metal tape. SL (cm) was measured with a caliper as the distance between the tip of the scrotal sack and its neck.

Least squares analysis of variance was done using the general linear model (GLM), procedure of the statistical analysis system (SAS, 2007). The fixed effects fitted for testicular measurements included the discrete effects of breed (B), type of birth (BT), age of lamb (A) which was fitted as a covariate. Coefficients of correlations and determination among testicular measurements and ram lamb age, body weight and type of birth were estimated. Regression equations between the above factors were calculated.

Results and Discussion

Tables 1, 2, 3 and 4 summarize results of least square analysis of variance for testicular measurements in ram lambs at 90, 120, 150 and 180 days of age, respectively. Effects of breed and birth type in the model were significant ($P<0.05$) for body weight at all ages. Breed was significant ($P<0.05$) all of the testicular measurements, except testicular diameter at 90 days of age and testicular length at 120 days of age. Effect of some continual and crucial environmental factors on the testicular characteristics was researched. The trend of testicular and scrotal development noticed in this study was similar to that described by Toe et al. (2000) in Menz and Horro lambs, Salhab et al. (2001) Awassi lambs, Emsen (2005) Awassi and Redkaraman lambs and Koyuncu et al. (2005) Kivircik lambs. A gradual and rapid increase in TD, TL, SC and SL was observed from 90 to 180 days of age. Lambs were in a stage of rapid sexual development as determined by increase in testicular size. Testis diameter generally increased until about 34 weeks of age and showed seasonal variations thereafter in Suffolk lambs recorded by Moore and Sanford (1985). In another research sires influenced the testis diameter of the progeny, and effects of sires showed seasonal varia-

Table 1
Least square means (and s.e) of body weight and testicular traits at 90 days of age for breed and birth type[a]

Item	BW, kg	TD, cm	TL, cm	SC, cm	SL, cm
Overall	31.8 (0.62)	2.6 (0.17)	4.6 (0.15)	15.3 (0.84)	11.1 (0.27)
Breed	*	NS	*	*	NS
Kivircik	28.9 (0.97)	2.6 (0.28)	4.5 (0.23)	14.8 (0.53)	10.6 (0.22)
Karacabey Merino	34.3 (1.24)	2.4 (0.14)	4.3 (0.19)	14.8 (0.72)	11.4 (0.24)
Tahirova	32.2 (1.46)	2.8 (0.12)	5.0 (0.18)	16.2 (0.67)	11.0 (0.36)
Birth type	*	NS	NS	NS	NS
Single	33.3 (0.92)	2.7 (0.11)	4.8 (0.14)	15.6 (0.73)	11.2 (0.31)
Multiple	30.3 (1.21)	2.5 (0.17)	4.5 (0.23)	15.0 (0.81)	10.9 (0.25)

*p<0.05

tions. Sires also influenced the percentage of abnormal spermatozoa, but the effect was lower than that on the testis diameter (Colas et al., 1990) (Tables 1 and 2).

Tahirova lambs having a larger testicular measurement than Kivircik and Karacabey Merino lambs at 90, 120, 150, and 180 days of age. Birth type was not significant ($P>0.05$) for any of the testicular measurements. Multiple-born lambs had smaller TD, TL, SC, and SL than single-born lambs, but the differences were not significant at all ages ($P>0.05$). Report from the study Shrestha et al. (1983) indicate did not observe significant effects of type of birth on testis length and testis width at 6, 8 and 10 month of age in ram lambs of several breeds maintained in a controlled environment. In contrast to this, study and ours are the results of Purvis (1986) and Matos et al. (1992). These authors indicate significant effects of type of birth on testicular measurements in ram lambs (Tables 3 and 4).

Like our results, previous reports have shown that SC in the ram varies according to both age and body weight (Braun et al. 1980). Another study suggests, however, that season and breed had more effect on SC than did body weight (Mickelsen et al., 1981). It is known that a decrease in SC results in a increase in morphologically abnormal sperm (Mickelsen et al. 1982), why the clinically convenient SC measurement deserves a wider application as an estimate of testes weight and therefore fertility in rams (Söderquist and Hulte'n, 2006). SC, a high heritable trait, is considered as an excellent index of sperm production in the ram (Toe et al., 2000).

Table 5 presents estimates of phenotypic correlations among testicular measurements in ram lambs and between these testicular measurements and body weight at three sheep breeds. As it was expected, the various measurements of testis were correlated positively and significantly ($P<0.01$) with each other.

Age and body weight of K, KM and T ram lambs were positively correlated with the four testicular measurements ($r = 0.469–0.832$, $P<0.01$). The highest correlations coefficients calculated were those with the scro-

Table 2
Least square means (and s.e) of body weight and testicular traits at 120 days of age for breed and birth type

	BW, kg	TD, cm	TL, cm	SC, cm	SL, cm
Overall	34.1 (0.71)	3.1 (0.17)	5.1 (0.16)	18.7 (0.56)	11.3 (0.27)
Breed	*	*	NS	*	NS
Kivircik	30.6 (0.73)	3.2 (0.11)	5.1 (0.26)	18.7 (0.63)	10.8 (0.24)
Karacabey Merino	36.7 (0.84)	2.7 (0.19)	4.5 (0.15)	16.8 (0.46)	11.6 (0.27)
Tahirova	34.9 (0.71)	3.5 (0.13)	5.6 (0.16)	20.6 (0.91)	11.6 (0.30)
Birth type	NS	NS	NS	NS	NS
Single	35.3 (1.52)	3.2 (0.24)	5.2 (0.14)	19.1 (0.87)	11.3 (0.24)
Multiple	32.8 (0.86)	3.0 (0.14)	4.9 (0.29)	18.3 (0.51)	11.3 (0.36)

*p<0.05

Table 3
Least square means (and s.e) of body weight and testicular traits at 150 days of age for breed and birth type

	BW, kg	TD, cm	TL, cm	SC, cm	SL, cm
Overall	35.4 (0.66)	3.9 (0.17)	6.3 (0.28)	23.8 (0.47)	14.8 (0.34)
Breed	*	*	*	*	*
Kivircik	34.0 (1.52)	4.0 (0.12)	6.6 (0.18)	24.2 (0.81)	14.0 (0.41)
Karacabey Merino	34.6 (0.96)	3.4 (0.19)	5.5 (0.16)	21.8 (0.56)	15.9 (0.57)
Tahirova	37.6 (0.84)	4.2 (0.14)	6.7 (0.24)	25.5 (0.48)	14.6 (0.49)
Birth type	*	NS	NS	NS	NS
Single	36.7 (0.97)	4.0 (0.19)	6.5 (0.34)	24.3 (0.94)	15.0 (0.64)
Multiple	34.0 (1.25)	3.8 (0.12)	6.1 (0.27)	23.3 (0.87)	14.7 (0.54)

*p<0.05

tal circumference (r = 0.81–0832). Similarly Zeng and Lu (1987), Foster et al. (1989), Ozturk et al. (1996) and Koyuncu et al. (2005) reported high significant correlations between body weight and testicular measurements. Salhab et al. (2001) reported that the various testicular measurements are more correlated with body weight of growing lambs than age. Thus, the early pubertal development associated with increased body weight is desirable in terms of improved reproductive performance. Testicular parameters were positively correlated with each other (r = 0.756-0.943, P<0.01) in K, KM and T ram lambs. These results were in agreement with findings of Foster et al. (1989), Koyuncu et al. (2000), Salhab et al. (2001) and Koyuncu et al. (2005).

Regression equations between testicular measurements, birth type, age and body weight together with estimates of coefficient of determination for the three sheep breeds are presented in Table 6. All listed characteristics confirm the existence of linear relationships between testicular measurements and body weight when age is taken as constant (P<0.01)

Regression equations describe the relationship between testicular measurements (cm) and the age (day) as well as the body weight (kg) of K, KM and T ram

Table 4
Least square means (and s.e) of body weight and testicular traits at 180 days of age for breed and birth type

	BW, kg	TD, cm	TL, cm	SC, cm	SL, cm
Overall	41.0 (1.25)	4.7 (0.19)	7.6 (0.27)	26.6 (0.95)	16.5 (0.32)
Breed	*	*	*	*	NS
Kivircik	38.6 (1.07)	4.9 (0.17)	7.9 (0.14)	27.1 (0.36)	16.5 (0.43)
Karacabey Merino	41.8 (1.27)	4.1 (0.14)	6.8 (0.28)	25.1 (0.47)	16.8 (0.34)
Tahirova	42.5 (1.36)	5.0 (0.10)	8.0 (0.31)	27.5 (0.59)	16.2 (0.30)
Birth type	NS	NS	NS	NS	NS
Single	41.7 (1.17)	4.9 (0.16)	7.7 (0.26)	27.0 (0.48)	16.6 (0.44)
Multiple	40.2 (0.97)	4.6 (0.12)	7.4 (0.17)	26.1 (0.87)	16.5 (0.35)

*p<0.05

Table 5
Phenotypic correlations among testicular measurements and body weight in growing Kivircik, Karacabey Merino and Tahirova ram lambs*

Breed	Measurements	A	BW	TD	TL	SL
	BW	0.649	-	-	-	-
	TD	0.811	0.805	-	-	-
Kivircik	TL	0.798	0.807	0.924	-	-
	SL	0.781	0.727	0.807	0.837	-
	SC	0.832	0.819	0.943	0.936	0.815
	BW	0.612	-	-	-	-
	TD	0.759	0.781	-	-	-
Karacabey Merino	TL	0.737	0.779	0.908	-	-
	SL	0.754	0.626	0.756	0.774	-
	SC	0.783	0.753	0.924	0.902	0.792
	BW	0.353	-	-	-	-
	TD	0.657	0.674	-	-	-
Tahirova	TL	0.636	0.697	0.948	-	-
	SL	0.742	0.469	0.767	0.751	-
	SC	0.760	0.638	0.933	0.913	0.837

*all coefficients are statistically significant (p<0.01)

Table 6
The regression equations and coefficient of determination (R2) for the testicular measurements of the three sheep breeds

Breed	Parameter	Regression equations	R^2
Kivircik	TD	-1.67+0.026BT+0.0163A+0.095BW	0.789**
	TL	-2.71+0.269BT+0.0231A+0.160BW	0.783**
	SL	-1.10+0.680BT+0.0438A+0.217BW	0.701**
	SC	-8.77+0.691BT+0.0872A+0.519BW	0.828**
Karacabey Merino	TD	-1.75+0.279BT+0.0144A+0.088BW	0.748**
	TL	-1.46+0.425BT+0.0184A+0.126BW	0.730**
	SL	1.65+0.327BT+0.0503A+0.120BW	0.609**
	SC	-5.60+1.420BT+0.0849A+0.393BW	0.744**
Tahirova	TD	-0.915-0.449BT+0.0157A+0.072BW	0.687**
	TL	-0.648-0.688BT+0.0213A+0.111BW	0.694**
	SL	1.790-0.426BT+0.0643A+0.112BW	0.597**
	SC	-2.581-1.770BT+0.0995A+0.310BW	0.751**

**p<0.01

lambs. These equations revealed that testis measurements showed a positive relationship with birth type, age and body weight of three ram lambs breeds. These results are in agreement with findings of Mukasa-Mugerva and Azaz (1992), Salhab et al. (2001) and Koyuncu et al. (2005).

Conclusion

The results of this study indicate that suitability of testicular measurements as criteria for early selection of Kivircik, Karacabey Merino and Tahirova ram lambs. On the other hand, the selection of breeding rams based only on testicular measurements is not sufficient. Further studies on testosterone and spermatogenetic activity are needed to confirm the present results.

References

Braun, W. F., J. M., Thompson and C. V. Ross, 1980. Preliminary report on ram scrotal circumference measurements. *Social Theriogenol,* **10:** 44-50.

Colas, G., J. Lefebre and Y. Guerin, 1990. A study of the transmission from sire to male progeny of seasonal variations in testis diameter and percentage of abnormal spermatozoa in Ile de France ram. *Reproduction Nutrition Development,* **30**: 589-603.

Dyrmundsson, O. R. and J. L. Less, 1972. Puberal development of Clun Forest ram lambs in relation to time of birth. *Journal of Agrıcultural Scıence (Camb)*, **79**: 83-89.

El-Wishy, A. B. and S. A. El-Sawaf, 1971. Development of sexual activity in male Damascus goats. *Indian Journal of Animal Science,* **41**: 350-356.

Emsen, E., 2005. Testicular development and body weight gain from birth to 1 year of age of Awassi and Regkaraman sheep and their reciprocal crosses. *Small Ruminant Research,* **59**: 79-82.

Foster, R. A., P. W. Ladds, D. Hoffmann and G. O. Briggs, 1989. The relationship of scrotal circumference to testicular weight in rams. *Australian Veterinary Journal,* **66**: 20-22.

Koyuncu, M., L. Sengul and E. Tuncel, 2000. Some characteristics of testis in Karayaka hoggets. *Journal of Animal Production,* **41**: 102-107.

Koyuncu, M., S. Kara Uzun, S. Ozis and S. Duru, 2005. Development of testicular dimensions and size, and their relationship to age and body weight in growing Kivircik (Western Thrace) ram lambs. *Czech Journal of Animal Science,* **50** (6): 243-248.

Land, R. B. and W. R. Carr, 1975. Testes growth and plasma LH concentration following hemi castration and its relation with female prolificacy in sheep. *Journal of Reproduction and Fertility*, **45**: 495.

Lauda, F., J. M. Doney, L. Sbole, J. Krivek and J. Smerha, 1981. The development of sexual activity and semen production in ram lambs of two prolific breeds, Romanov and Finnish Landrace. *Animal Production,* **33**: 143-148.

Matos, C. A. P., D. L. Thomas, T. G. Nash, D. F. Waldron and J. M. Stookey, 1992. Genetic analyses of scrotal circumference size and growth in Rambouillet lambs. *Journal of Animal Science,* **70**: 43-50.

Mickelsen, W. D., L. G. Paisley and J. J. Dahmenn, 1981. The effect of season on the scrotal circumference and sperm motility and morphology in rams. *Theriogenology,* **16**: 45-41.

Mickelsen, W. D., L. G. Paisley and J. J. Dahmenn, 1982. Seasonal variations in scrotal circumference, sperm quality, and sexual ability in rams. *Journal of the American Veterinary Medical Association,* **181**: 376-380.

Moore, C. and L. M. Sanford, 1985. Genetic influence of predictability of testis function of rams. Research Reports Department of Animal Science, McGill University, 71-78.

Mukasa-Mugerva, E. and Z. Ezaz, 1992. Relationship of testicular growth and size to age, body weight and onset of puberty in Menz ram lambs. *Theriogenology,* **38** (5): 979-988.

Öztürk, A., B. Dağ and U. Zülkadir, 1996. Akkaraman ve İvesi koçların bazı testis özelliklerinin döl verimine etkisi. *Türk Veterinerlik ve Hayvancılık Dergisi,* **20** (2): 127-130.

Purvis, I. W., 1986. Phenotypic and genetic variation in male morphological reproductive traits. Ph.D. Thesis. Univ. of New England, Ermidale, New South Wales, Australia.

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

SAS, 2007. SAS User's Guide: SAS Institute Inc., Cary, NC.

Shhrestha, J. N. B., P. S. Fiser, G. A. Langford and D. P. Heaney, 1983. Influence of breed, birth date, age and body weight on testicular measurements of growing rams maintained in a controlled environment. *Canadian Journal of Animal Science,* **63**: 835.

Söderquist, L. and F. Hulten, 2006. Normal values fort he scrotal circumference in rams of Gotlandic breed. *Reproduction in Domestic Animals,* **41**: 61-62.

Yalcin, B. C., 1986. Sheep and Goats in Turkey. Food and Agriculture Organization of the United Nations, *Animal Production and Health*, Paper No: 60, Rome.

Zeng, Y. H. and B. Q. Lu, 1987. The development of sexual activity and semen production in ram lambs of The Hu breed of sheep. *Chinese Journal of Animal Science,* **3**: 5-8.

Toe, T., J. E. O. Rege, E. Mukasa-Mugerwa, S. Tembely, D. Anindo, R. L. Baker and A. Lahlou-Kassi, 2000. Reproductive characteristics of Ethiopian highland sheep I. Genetic parameters of testicular measurements in ram lambs and relationship with age at pubert in ewe lambs. *Small Ruminant Research*, **36**: 227-240.

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