Investigating various performance traits of Karakul sheep

Halil EROL[1,a,✉], Ceyhan ÖZBEYAZ[2,b], Necmettin ÜNAL[2,c]

[1]Edremit Directorate of District Agriculture and Forestry, Balıkesir; [2]Ankara University, Faculty of Veterinary Medicine, Department of Animal Breeding and Husbandry, Ankara, Turkey.
[a]ORCID: 0000-0001-9728-7244; [b]ORCID: 0000-0002-3748-9992; [c]ORCID: 0000-0001-5250-7063.

Abstract: Karakul sheep in Turkey is an endangered breed according to the total number of ewes. Two herds of Karakul sheep in Tokat Province, reared similar environmental conditions, kept *in situ in vivo* conservation as a gene resource. This study aimed to determine various performance traits of Karakul sheep reared in breeder conditions as a gene resource. Least squares means for lambing rate (LR), litter size (LS) and lamb production (LP) were found 95.8±0.60%, 1.04±0.01 and 100.0±0.80%, respectively. It was determined that farm and age had significant effect on LR and LP, while farm and year had significant impact on LS. Survival rate in lambs were found 95.2 and 94.1%, respectively on 90th and 180th days. Means of least squares for live weights of lambs at birth and on 90th and 180th days were identified as 3.35±0.02, 21.52±0.27 and 30.34±0.32 kg, respectively. Live weight after shearing and greasy fleece weight values were 40.73±0.12 and 2.04±0.01 kg for females and 62.65±0.53 and 3.48±0.06 kg for males. Lactation milk yield (LMY) was 104.85±3.73 kg in ewes and lactation duration was 159.01±1.70 days. LMY was affected by the lactation number and farm while lactation duration was affected by lactation number. Results revealed that various performance traits of Karakul sheep conserved in breeder conditions were similar to or better than those previously reported for this breed. Also, the breed is similar to medium size native sheep breeds in terms of growth and mature live weight.

Keywords: Genetic resource, Karakul sheep, production traits

Karagül koyunlarında çeşitli verim özelliklerinin araştırılması

Özet: Türkiye'de Karagül koyunu, yok olma tehlikesi altında bulunan bir ırktır. Tokat ilinde birbirine yakın ve benzer çevresel koşullarda yetiştirilen iki Karagül koyun sürüsü, yetiştirici koşullarında gen kaynağı olarak korunmaktadır. Bu araştırma, yetiştirici koşullarında gen kaynağı olarak korunan Karagül koyunlarında çeşitli verim özelliklerinin incelenmesi amacıyla yapılmıştır. Koyunlarda doğum oranı, bir doğuma kuzu sayısı ve kuzu verimi için en küçük kareler ortalamaları % 95,8±0,60; 1,04±0,01 ve % 100,0±0,80 olmuştur. İşletme ve yaşın doğum oranına ve kuzu verimine; işletme ve yılın ise bir doğuma kuzu sayısına etkileri önemli bulunmuştur. Kuzularda 90. ve 180. günde yaşama gücü sırasıyla % 95,2 ve 94,1 olarak tespit edilmiştir. Kuzularda doğum, 90. ve 180. gün canlı ağırlıkları sırasıyla 3,35±0,02; 21,52±0,27 ve 30,34±0,32 kg belirlenmiştir. Kırkım sonrası canlı ağırlık ve yapağı verimi dişilerde 40,73±0,12 ve 2,04±0,01 kg, erkeklerde 62,65±0,53 ve 3,48±0,06 kg tespit edilmiştir. Koyunlarda laktasyon süt verimi 104,85±3,73 kg ve laktasyon süresi 159,01±1,70 gün olmuştur. Laktasyon süt verimine laktasyon sırası ve işletme, laktasyon süresine ise laktasyon sırasının etkisi önemli olmuştur. Sonuç olarak yetiştirici koşullarında korunan Karagül koyunlarında genel olarak çeşitli verim özelliklerinin ırk için bildirilen değerlere benzer veya daha iyi olduğu belirlenmiştir. Ayrıca Karagül ırkı, canlı ağırlık ve büyüme bakımından orta yapılı yerli koyun ırklarına benzerlik göstermektedir.

Anahtar sözcükler: Gen kaynağı, Karagül koyunu, verim özellikleri

Introduction

Karakul is a fat-tailed sheep breed with coarse fleece (1). This breed is called after Karakul town in Turkmenistan (1) or Karagöl located in the city of Bukhara in Uzbekistan (2). The most significant characteristic of this breed is the Astrakhan fur obtained from the newborn lambs. It has been reported that Karakul breed was first brought to Tokat and Antalya in Turkey by the families who migrated from Caucasia at the end of 19th century

(22). Later, rams and ewes were brought from Turkistan in 1929 to start breeding (2, 11). Breeding was undertaken in many state institutions led by Çifteler (Eskişehir) and Kazova (Tokat); however, subsequently breeding in these state farms was terminated. Today, Karakul sheep are bred only in Tokat vicinity at a small scale. Because total number of Karakul ewes has decreased considerably, Karakul breed in Turkey was accepted as an endangered breed (8). Therefore, two herds (a total of 320-head) were

conserved in the framework of the project to conserve the genetic resources of domesticated animals. Previous studies, carried out in the 1960s, investigating Karakul sheep in Turkey were mostly related to curl forms and skin structure (6, 7, 11). Some studies performed in 2000s were published on milk (16), fleece (17), fertility (23), and some production traits (13). A number of production traits of ewes and lambs in the Karakul herds during the period of 2005-2008, in which the current research was conducted, were reported (13). The current study includes fertility, live weight after shearing, greasy fleece yield, milk yield and some udder measurements along with lamb survival rates and growth characteristics of the herds from 2011 to 2015.

Karakul sheep breed has been reared for a long time in Anatolia and it is one of components of biodiversity of Turkey. This breed faces a challenge of the need to increase production traits to provide sustainable production. Astrakhan fur, the most important yield of the breed, is not generally utilized in Turkey, and so the existence of the breed depends on the use of other yield characteristics. For this reason, it is important to know the current information about production traits of the breed.

The study aimed to investigate fertility, survival ability, growth, production of milk and wool of Karakul sheep under *in situ in vivo* conservation.

Material and Methods

The study was conducted on two Karakul sheep herds reared in Gülpınar and Ulaş villages of Tokat province (Gülpınar and Ulaş villages are situated between 40° 18' 03"- 40° 18' 48" east longitude and 36° 26' 11"- 36° 23' 07" north latitude and elevation from sea level is 630 m). Data on the number of ewes, the performance traits of which were under investigation are presented in the form of tables. Husbandry and feeding conditions were generally similar in the farms where the project was carried out. The distance between the two farms is 7 km. Ewes in both herds were fed on pasture during the first 3/5 period of gestation, and were offered with 400 g of concentrate feed (14.0% crude protein and 2400 kcal ME/kg) and roughage (400 g sugar beet pulp and 500 g vetch plus barley straw) per ewe daily during the last 2/5 period of gestation. The ewes were kept indoors during the first 6 weeks of lactation period and fed similar to the last period of gestation. After indoor keeping, the ewes were fed on pasture during the rest of lactation period.

Ewes mating was conducted as random mating. Lambing rate (LR) and lamb production (LP) were calculated according to the number of ewes exposed to rams and litter size (LS) was calculated based on the number of ewes lambing. Survival rate (SR) of lambs was based on lambs born alive. The date of birth, gender and age of dam were recorded at birth along with their birth weight no later than 24 hours after the birth. The lambs

were received alfalfa hay and lamb grower feed. The growth of lambs was recorded and live weight on the 90th and 180th days was calculated by using interpolation method. Ewes were shorn in June every year. Greasy fleece weight and live weight after shearing were identified with the help of electronic bascules sensitive to 50 g.

Milk yield controls were conducted in 2013 on a total of 30 ewes per herd randomly selected from both herds with single births at the second week of February and were in the 1st, 2nd and 3rd lactation. The first milk control was conducted about on the 45th day after the birth and controls were continued about 90 and 135 days after parturition. The data for the lactation milk yield (LMY) were calculated by interpolation and extrapolation methods. The lactation duration (LD) was calculated as the period between the date of birth and the end of lactation. The end of lactation was determined by extrapolation method based on the last milk control day.

The lambs were separated from their mother one day before the milk control day at 17.00 and the ewes were milked by hand on the milk control day around at 08.00 and 17.00. Lambs in both herds were not weaned until the last control milking and went to the pasture with the ewes. LMY was calculated by using Fleischmann's method (TrapezII). Udder measurements were collected right before the 1st and the 3rd milk control days of lactation with the help of measuring tape and digital calipers (18).

Statistical analysis: Fertility, greasy fleece weight, lactation milk yield, lactation duration and udder measurements in ewes and growth characteristics in lambs were examined with the Least Squares Method. Duncan's Multiple Comparison Test was used to compare more than two groups with significant differences. Survival rate in lambs was analyzed using Chi-Square Method (9).

Results

Table 1 presents the ewes fertility characteristics of which were assessed and Table 2 presents the least squares means for fertility characteristics. Mean least squares for LR, LS and LP in ewes were 95.8±0.60%, 1.04±0.01 and 100.0±0.80%, respectively. It was found that farm and age (P <0.05) affected LR, farm (P <0.001) and year (P <0.01) affected LS and farm (P <0.001) and age (P <0.05) affected LP (Table 2).

Survival rates of lambs on the 90th and 180th days were found 95.2 and 94.1% (Table 3) and the impact of the examined factors were generally insignificant. Table 4 presents the means of the live weights of the lambs at different stages. Live weights at birth and the 90th and 180th days of lambs were found 3.35±0.02, 21.52±0.27 and 30.34±0.32 kg, respectively. The effects of the examined factors on the live weight of lambs at different periods were found significant at different levels (P <0.05; P <0.01; P <0.001).

Table 1. Number of ewes investigated for the fertility traits by the farm and year subclasses

Farm	Age	2011-2012	2012-2013	2013-2014	2014-2015	General
	2	38	26	16	35	115
	3	46	34	27	16	123
	4	24	47	33	27	131
Gülpınar	5	22	21	43	32	118
	6≥	20	29	38	67	154
	Total	150	157	157	177	641
	2	35	18	27	25	105
	3	35	36	18	27	116
	4	24	31	35	18	108
Ulaş	5	22	23	30	35	110
	6≥	24	32	39	53	148
	Total	140	140	149	158	587
	2	73	44	43	60	220
	3	81	70	45	43	239
	4	48	78	68	45	239
General	5	44	44	73	67	228
	6≥	44	61	77	120	302
	Total	290	297	306	335	1228

Table 2. Numerical values and the least squares means (±SEM) for fertility traits

Items	NME	NLE	NSLE	NMLE	NLBA	LSM±SE		
						LR (%)	LP (%)	LS (x100)
Farm						*	***	***
Gülpınar	641	606	592	14	620	94.4±0.80	96.7±1.10	102.4±0.80
Ulaş	587	571	535	36	607	97.1±0.80	103.4±1.20	106.5±0.80
Age						*	*	-
2	220	202	197	5	207	91.9±1.30[a]	94.4±1.90[a]	102.6±1.40
3	239	232	224	8	240	97.3±1.30[b]	100.3±1.80[b]	103.1±1.30
4	239	228	215	13	241	95.5±1.30[b]	100.9±1.80[b]	105.6±1.30
5	228	221	206	15	236	96.8±1.30[b]	103.9±1.90[b]	107.3±1.30
6≥	302	294	285	9	303	97.2±1.20[b]	100.6±1.70[b]	103.6±1.20
Year						-	-	**
2011-2012	290	275	264	11	286	95.1±1.20	99.2±1.70	104.3±1.20[ab]
2012-2013	297	283	260	23	306	95.2±1.20	103.1±1.70	108.3±1.20[b]
2013-2014	306	296	288	8	304	96.5±1.10	98.9±1.60	102.4±1.20[a]
2014-2015	335	323	315	8	331	96.3±1.10	98.9±1.60	102.6±1.10[a]
Interactions								
FxA						-	-	-
FxY						-	-	-
AxY						-	-	-
General	1228	1177	1127	50	1227	95.8±0.60	100.0±0.80	104.4±0.60

F: Farm, A: Age, Y: Year, - P>0.05, * P<0.05, ** P<0.01, *** P<0.001
[a, b] Differences between the means with unlike letters in the same column are significant at P <0.05.
LSM: Least squares means, SE: Standard error, NME: Number of mating ewes, NLE: Number of lambing ewes, NSLE: Number of single lambing ewes, NMLE: Number of multiple lambing ewes, NLBA: Number of lambs born alive, LR: Lambing rate, LP: Lamb production, LS: Litter size

Table 3. Number of lambs born alive and survival rates at different periods

Items	Number of lambs (n)			Survival rate (%)	
	Live birth	90th day	180th day	90th day	180th day
Farm				*	*
Gülpınar	620	602	596	96.9	96.0
Ulaş	607	567	560	93.4	92.3
Dam Age				-	-
2	207	194	192	93.7	92.8
3	240	230	227	95.8	94.2
4	241	233	232	96.7	96.3
5	236	228	226	96.2	95.8
6≥	303	284	279	93.7	92.1
Birth Year				-	-
2012	286	271	268	94.8	93.4
2013	306	288	283	94.1	92.5
2014	304	294	293	96.4	96.4
2015	331	316	312	95.5	94.3
Gender				-	-
Female	603	572	565	94.7	93.7
Male	624	597	591	95.7	94.6
Birth Type				-	-
Single	1127	1077	1066	95.5	94.5
Twin	100	92	90	92.0	90.0
General	1227	1169	1156	95.2	94.1

- P>0.05, * P<0.05

Table 4. The least squares means (±SEM) for live weight at different ages (kg)

Items	n	Birth	n	90th day	n	180th day
Farm		**		*		**
Gülpınar	620	3.28±0.04	602	22.01±0.41	596	29.55±0.49
Ulaş	607	3.41±0.03	567	21.03±0.30	560	31.13±0.35
Dam Age		-		-		-
2	207	3.22±0.07	194	21.55±0.71	192	29.67±0.84
3	240	3.34±0.05	230	21.90±0.48	227	30.88±0.57
4	241	3.42±0.04	233	22.15±0.44	232	30.92±0.53
5	236	3.34±0.04	228	21.58±0.44	226	30.92±0.54
6≥	303	3.41±0.04	284	20.42±0.46	279	29.32±0.57
Birth Year		***		***		***
2012	286	3.18±0.04[a]	271	19.14±0.47[a]	268	28.08±0.57[a]
2013	306	3.41±0.03[b]	288	22.41±0.35[b]	283	30.00±0.43[b]
2014	304	3.48±0.05[b]	294	22.78±0.53[b]	293	30.88±0.63[b]
2015	331	3.32±0.05[c]	316	21.75±0.54[c]	312	32.40±0.63[c]
Gender		***		*		***
Female	603	3.23±0.03	572	21.16±0.33	565	29.53±0.39
Male	624	3.47±0.03	597	21.88±0.35	591	31.15±0.42
Birth Type		***		*		***
Single	1127	3.76±0.01	1077	22.10±0.11	1066	31.72±0.13
Twin	100	2.93±0.05	92	20.94±0.53	90	28.96±0.63
Interactions						
FxDA		***		-		-
FxBY		***		***		***
FxG		-		*		***
FxBT		-		-		-
DAxBY		**		-		-
DAxG		-		-		-
DAxBT		-		-		-
BYxG		**		-		-
BYxBT		***		-		-
GxBT		-		-		-
Regression				1.603±0.291***		1.564±0.356***
General	1227	3.35±0.02		21.52±0.27		30.34±0.32

F: Farm, DA: Dam Age, BY: Birth Year, G: Gender, BT: Birth Type, - P>0.05, * P<0.05, *** P<0.001
[a, b, c] Differences between the means with unlike letters in the same column are significant at P<0.05.
Regression: Partial regression of live weight on birth weight.

Live weight after shearing was 40.73±0.12 and 62.65±0.53 and greasy fleece weight were 2.04±0.01 and 3.48±0.06 kg in ewes and rams, respectively. The impact of the examined factors were found significant in general (P <0.05; P <0.01; P <0.001), (Table 5).

Table 6 presents the least squares means for LMY and LD, and Table 7 shows the least squares means for udder measurements. LMY and LD were determined to be

104.85±3.73 kg and 159.01±1.70 days, respectively. Udder circumference on the 45th day of lactation was found 44.20±0.37 cm and teat-floor distance 26.48±0.15 cm. It was identified that lactation number and farm affected LMY (P <0.01) and lactation number affected the LD (P <0.05). The udder measurement values except teat-floor distance was found to decrease when lactation progressed (Table 7).

Table 5. The least squares means (±SEM) for live weight after shearing and greasy fleece weight (kg)

Items	Live weight after shearing				Greasy fleece weight			
	n	Ewes	n	Rams	n	Ewes	n	Rams
Farm		***		***		***		*
Gülpınar	692	40.23±0.13	49	60.78±0.73	685	1.88±0.02	49	3.43±0.09
Ulaş	628	41.23±0.14	60	64.52±0.79	628	2.20±0.02	60	3.54±0.08
Age		***		***		***		***
1.5	164	35.54±0.28[a]	48	42.59±0.95[a]	164	1.91±0.03[a]	48	2.86±0.10[a]
2.5	206	40.50±0.23[b]	26	63.29±0.99[b]	206	2.03±0.03[b]	26	3.46±0.11[b]
3.5	229	42.60±0.22[c]	18	69.72±1.15[c]	228	2.12±0.03[bc]	18	3.97±0.12[c]
4.5	233	42.43±0.22[c]	17	74.99±1.23[d]	230	2.14±0.03[c]	17	3.65±0.13[b]
5.5	248	42.01±0.22[c]			248	2.03±0.02[b]		
6≥	240	41.29±0.24[bc]			237	2.00±0.03[b]		
Year		***		***		***		***
2012	329	39.59±0.19[a]	18	57.96±1.15[a]	329	1.99±0.02[a]	18	3.23±0.12[a]
2013	328	40.82±0.18[b]	29	62.31±1.09[b]	327	2.05±0.02[ab]	29	3.24±0.12[a]
2014	331	40.44±0.20[b]	31	63.52±1.12[b]	327	1.97±0.02[a]	31	3.70±0.12[b]
2015	332	42.07±0.20[c]	31	66.81±0.92[c]	330	2.15±0.03[b]	31	3.76±0.10[b]
Interactions								
FxA		-		***		***		***
FxY		***		***		***		-
AxY		**		-		***		-
General	1320	40.73±0.12	109	62.65±0.53	1313	2.04±0.01	109	3.48±0.06

F: Farm, A: Age, Y: Year, - P>0.05, * P<0.05, ** P<0.01, *** P<0.001
a, b, c, d Differences between the means with unlike letters in the same column are significant at P<0.05.

Table 6. Some descriptive values and the least squares means (±SEM) for lactation milk yield and lactation duration

Items	n	LMY (kg)	Min	Max	LD (day)	Min	Max
LN		**			*		
1	20	92.12±4.56[a]	44	128	153.41±2.91[a]	130	169
2	19	112.09±4.68[b]	74	174	158.24±2.99[ab]	136	187
3	20	110.33±4.56[b]	85	141	165.38±2.91[b]	143	202
Farm		**			-		
Gülpınar	29	97.50±3.79	44	128	156.21±2.42	130	202
Ulaş	39	112.19±3.73	74	174	161.81±2.38	136	187
Interaction							
LNxF		-			-		
General	59	104.85±3.73	44	174	159.01±1.70	130	202

LMY: Lactation milk yield, LD: Lactation duration, LN: Lactation number, F: Farm, Min: Minimum, Max: Maximum, - P>0.05, * P<0.05, ** P<0.01
a, b Differences between the means with unlike letters in the same column are significant at P<0.05.

Table 7. The least squares means (±SEM) for some udder measurements (cm)

Items	n	Days					
		45th day	135th day	45th day	135th day	45th day	135th day
		Udder width		Udder depth		Udder circumference	
LN		*	**	-	-	-	-
2	22	13.17±0.21ᵃ	9.48±0.28ᵃ	14.70±0.18	11.64±0.56	42.98±0.63	28.73±0.88
3	20	13.95±0.22ᵇ	10.09±0.30ᵃᵇ	15.25±0.18	11.35±0.60	44.78±0.65	30.34±0.95
4	22	13.92±0.21ᵇ	10.74±0.27ᵇ	14.94±0.18	12.37±0.56	44.84±0.62	31.14±0.88
Farm		**	-	-	-	***	-
Gülpınar	31	13.31±0.18	9.99±0.24	14.86±0.15	11.16±048	45.74±0.53	30.50±0.75
Ulaş	33	14.05±0.17	10.22±0.22	15.06±0.14	12.41±0.45	42.66±0.51	29.64±0.72
Interaction							
LNxF		**	-	-	-	*	-
General	64	13.68±0.12	10.10±0.16	14.96±0.10	11.79±0.33	44.20±0.37	30.07±0.52
		Length of right teat		Length of left teat		Diameter of right teat	
LN		**	*	*	-	*	*
2		2.93±0.12ᵃ	2.25±0.07ᵃ	3.00±0.13ᵃ	2.34±0.07	1.64±0.05ᵃ	1.31±0.03ᵃ
3		3.41±0.13ᵇ	2.46±0.07ᵃᵇ	3.38±0.13ᵃᵇ	2.48±0.07	1.87±0.05ᵇ	1.43±0.04ᵇ
4		3.53±0.12ᵇ	2.54±0.07ᵇ	3.47±0.12ᵇ	2.50±0.06	1.80±0.05ᵇ	1.42±0.03ᵇ
Farm		-	-	-	-	***	-
Gülpınar		3.27±0.10	2.36±0.06	3.24±0.11	2.41±0.06	1.88±0.04	1.40±0.03
Ulaş		3.31±0.10	2.47±0.06	3.32±0.10	2.47±0.05	1.63±0.04	1.38±0.03
Interaction							
LNxF		-	*	-	-	-	**
General		3.29±0.07	2.42±0.04	3.28±0.073	2.44±0.04	1.76±0.03	1.39±0.02
		Diameter of left teats		Distance between teats		Teat-floor distance	
LN		-	**	-	-	-	-
2		1.61±0.05	1.27±0.03ᵃ	16.83±0.38	13.22±0.23	26.64±0.26	29.94±0.46
3		1.71±0.05	1.41±0.03ᵇ	17.71±0.40	13.29±0.25	26.45±0.27	29.66±0.49
4		1.72±0.05	1.42±0.03ᵇ	17.75±0.38	13.76±0.23	26.34±0.26	28.77±0.45
Farm		***	-	-	-	-	*
Gülpınar		1.80±0.04	1.40±0.03	17.29±0.32	13.27±0.20	26.53±0.22	30.04±0.39
Ulaş		1.56±0.04	1.34±0.02	17.56±0.31	13.58±0.19	26.43±0.21	28.87±0.37
Interaction							
LNxF		-	*	-	-	-	-
General		1.68±0.03	1.37±0.02	17.43±0.22	13.42±0.14	26.48±0.15	29.46±0.27

LN: Lactation number, F: Farm, - P>0.05, * P<0.05, ** P<0.01, *** P<0.001
ᵃ, ᵇ Differences between the means with unlike letters in the same column are significant at P<0.05.

Discussion and Conclusion

Lambing rate (LR) (95.8%) obtained in this study is a rather high value for native sheep breeds. As a matter of fact, LR values were found higher than the values reported for the same breed (85.0 - 91.4%) (13, 15, 23) and some of the other fat tailed breeds (Akkaraman, Morkaraman) (67.6 - 90.5%) (3, 12). The high lambing rate in both farms indicates that environmental conditions were taken into consideration during the mating period. Fertility characteristics were considered to be the lowest in two years old ewes. Litter size (LS) obtained from Karakul ewes (1.04) was identified similar to the values reported for the same breed (1.00 - 1.18) (11, 13, 15, 23). The Karakul breed has of low value in terms of LS and is similar to the Dağlıç (1.05) (10) and Karayaka (1.03 - 1.08) (5, 20) in this respect. The low LS in Karakul herds is due to the low rate of twin birth; this shows that although the breed has a high LR, it is not a prolific breed.

There is only one study in the literature on the survival rate (SR) of Karakul lambs in Turkey (13). In the present study, SR values at 90th and 180th days (95.2 and 94.1%) were found similar to those identified for the same herds from 2006 to 2008, reported as 96.0 and 90.0%, in general (13). SR values obtained from lambs on the 90th and 180th days can be regarded as optimal and this is important for the sustainability of the herds.

The findings of the birth weight for female lambs (3.23 kg) and male lambs (3.47 kg) and the average live weight on the 180th days (30.34 kg) in this study were similar (3.24 and 3.47 kg) (11) or higher (3.03 and 3.23 kg) (13) than the those of values for birth weight of female and male lambs and live weight on the 180th day (24.62 kg) (13) of the same breed. When the live weights at birth, 90th and 180th days of the breed are evaluated together, it could be said that Karakul breed is similar to medium size breeds (Bafra, Dağlıç, Karayaka), but lower than the large size breeds (Akkaraman, Chios) in terms of the growth (1, 4, 5, 12, 19, 21).

The means obtained for the ewes live weight after shearing (40.73 kg) and greasy fleece weight (2.04 kg) were consistent with the those of results reported for the same breed (36.81 - 42.95 kg and 1.84 - 2.84 kg) (11, 13). In addition, live weight after shearing value was similar to the lower limit of range (42.70 - 62.60 kg) reported for some native breeds (5, 19).

LMY (104.85 kg) obtained in the current study was found higher than the means reported for the same breed (61.5 and 60.0 kg) (16, 22). The herd in Ulaş village is regularly milked each year; however, the herd in Gülpınar village was milked for the first time in the framework of the study. The fact that Ulaş herd gave 14.69 kg more milk than Gülpınar herd might be due to accustomed to hand milking. LMY and LD differed from the lactation number groups, while the first lactation ewes had numerically the lowest values than those of the other groups. This is in the line with the general understanding that milk production of ewes generally increases by lactation numbers. In this research, high lactation milk yield of the ewes shows that breeders can utility from Karakul breed in terms of milk yield. LD determined in this study (159.01 days) was found in the range of values reported for the same breed (137.9 - 168.0 days) (2, 16, 22). On the other hand, LD was similar in both herds. There was a wide variation in LMY and LD in both herds. This shows that it is possible to make improvement in the direction of milk yield in Karakul breed.

The longer the lactation duration was in Karakul sheep, the more decreasing was observed in udder measurement values other than the teat-floor distance. This is related to decreased milk yield due to progression of lactation. As a matter of fact, similar situation has been reported for various native breeds (3, 18). In general, udder measurement values obtained for Karakul ewes in this study were higher than those found for Tushin and Morkaraman ewes (14). Udder measurement values obtained for Bafra sheep (18) on the 42nd day of lactation were similar to or higher than the values found in the current study other than the values for right and left teat length and the distance between teats.

In conclusion, the performance traits of Karakul sheep were similar to or better than the those of results reported before for the same breed, and the breed was alike to medium size native breeds in terms of growth and mature live weight.

Conflict of Interest

The authors declared that there is no conflict of interest.

References

1. **Akçapınar H** (2000): Koyun yetiştiriciliği. ISBN: 975-96978-1-5, Ankara

2. **Aköz K (**1961): Karagül koyunu ve Karagül yetiştiriciliği. Lalahan Zootekni ve Araştırma Enstitüsü, Ankara.

3. **Akçapınar H, Kadak R, Odabaşıoğlu F** (1982): *Morkaraman ve Kangal-Akkaraman koyunlarının döl verimi ve süt verimi üzerinde karşılaştırmalı araştırmalar*. Ankara Univ Vet Fak Derg, **3-4**, 379-391.

4. **Akçapınar H, Özbeyaz C, Ünal N, et al** (2000): *The possibilities of developing dam and sire lines using Akkaraman, Sakız and Kıvırcık sheep breeds for lamb production I. Fertility in Akkaraman sheep, survival rate and growth characteristics of Sakız x Akkaraman F₁ and Kıvırcık x Akkaraman F₁ lambs*. Turk J Vet Anim Sci, **24**, 71-79.

5. **Akçapınar H, Ünal N, Atasoy F, et al** (2002): *Adaptation capability of Karayaka and Bafra (Chios x Karayaka B₁) genotypes reared in Lalahan Livestock Research conditions*. Lalahan Hay Araşt Enst Derg, **1**, 11-24.

6. **Aköz K, Öznacar K** (1960): *A comparative study on the forms of curly, brightness of the curls and birth weigths of purebred Afgan Karakul lambs' raised at Lalahan Animal Breeding Station and purebred Karakul lambs' raised at Çifteler Hara*. Lalahan Zoot Araş Enst Derg, **7**, 65-78.

7. **Aköz K** (1960): *The relationship between finest of the Karakul ewes wool fibers and curle conformation of the new born Karakul lambs*. Lalahan Zoot Araşt Enst Derg, **7**, 21-27.

8. **Anonymous** (2015): *Animal genetic resources for food and agriculture, The second report on the state of the world's*. FAO Commission on Genetic Resources for Food and Agriculture Assessments, Rome.

9. **Anonymous** (2008): *SPSS Software, Statistical Package for the Social Sciences for Windows*. Statistical Innovations Inc (Version 14.01, No: 9869264), USA.

10. **Başpınar H** (1985): *A comparative study on the fertility, milk yield and fleece yield performances of main sheep*

brees in Turkey, kept under semi-intensive conditions. İstanbul Üniv Vet Fak Derg, **2**, 43-66.

11. **Batu S, Özcan H** (1966): *The most important morphological characters and yields of the Karakül sheep and the breeding system at Çifteler Stud Farm.* Lalahan Zoot Araşt Enst Derg, **1-2**, 135-139.

12. **Çolakoğlu N, Özbeyaz C** (1999): *Comparison of some production traits in Malya and Akkaraman Sheep.* Turk J Vet Anim Sci, **23**, 351-360.

13. **Erol H, Akçadağ Hİ** (2009): *Some production characteristics of Karagül sheep in situ conditions.* Lalahan Hay Araşt Enst Derg, **46**, 91-104.

14. **Kırmızıbayrak T, Aksoy AR, Saatci M, et al** (2005): *Milk yield and udder charecteristics in Tuj and Morkaraman ewes and the relationships between them.* Kafkas Üniv Vet Fak Derg, **1**, 11-15.

15. **Köseoğlu H** (1978): *Studies on the improvement of twinning rate with the use of hormones in Karakul sheep.* Lalahan Zoot Araşt Enst Derg, **3-4**, 64-67.

16. **Küçük M, Öztürk Y, Bayram D** (2000): *Comparison of milk yield characteristics on Hamdani, Karagül and Morkaraman breeds in semi-intensive conditions.* Y.Y.Ü. Vet Fak Derg, **1**, 44-48.

17. **Küçük M, Yılmaz O, Ateş CY** (2000): *The evaluation of Morkaraman, Hamdani and Karakul wool for carpet wool type.* YYÜ Vet Fak Derg, **2**, 54-59.

18. **Ünal N, Akçapınar H, Atasoy F, et al** (2008): *Some udder traits and growth of lambs and phenotypic correlations between those of traits with milking traits and milk production measured by various milk estimation methods in Bafra sheep.* Ankara Univ Vet Fak Derg, **55**, 117-124.

19. **Ünal N, Akçapınar H, Atasoy H, et al** (2004): *The body weight and fleece traits of White Karaman, Chios x White Karaman F₁, B₁, Kıvırcık x White Karaman F₁, B₁, Karayaka and Bafra sheep.* Lalahan Hay Araşt Enst Derg, **2**, 15-22.

20. **Ünal N, Atasoy F, Akçapınar H, et al** (2003): *Fertility traits, survival rate and growth characteristics of Karayaka and Bafra (Chios x Karayaka B₁) genotypes.* Turk J Vet Anim Sci, **27**, 265-272.

21. **Ünal N** (2002): *Survival rate, growth characteristics and some body measurements of Akkaraman and Sakiz (Chios) x Akkaraman F₁ lambs.* Turk J Vet Anim Sci, **26**, 109-116.

22. **Yalçın BC** (1986): Sheep and goats in Turkey. FAO Animal Production and Health Papaer, Number **60**, Rome.

23. **Yılmaz O, Odabaşıoğlu F** (2006): *Hamdani, Morkaraman ve Karagül koyunlarında kuzulatma sıklığının artırılması olanakları.* YYÜ Sağlık Bil Derg, **1**, 16-126.