Investigating various performance traits of Karakul sheep

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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 farm 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

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 Caucasus 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 Çifteker (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 Gülpinar and Ulaş villages of Tokat province (Gülpinar 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     |
| Gülpinar| 4   | 24        | 47        | 33        | 27        | 131     |
|        | 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     |
| Ulaş   | 4   | 24        | 31        | 35        | 18        | 108     |
|        | 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     |
| General| 4   | 48        | 78        | 68        | 45        | 239     |
|        | 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 | LR (%) | LP (%) | LS (x100) |
|---------|-----|-----|------|------|------|--------|--------|-----------|
| Farm    |     |     |      |      |      | **     | ***    | ***       |
| Gülpinar| 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 | 94.4±1.90 | 102.6±1.40 |
| 3       | 239 | 232 | 224  | 8    | 240  | 97.3±1.30 | 103.3±1.80 | 103.3±1.30 |
| 4       | 239 | 228 | 215  | 13   | 241  | 95.5±1.30 | 100.9±1.80 | 105.6±1.30 |
| 5       | 228 | 221 | 206  | 15   | 236  | 96.8±1.30 | 103.9±1.90 | 107.3±1.30 |
| 6+      | 302 | 294 | 285  | 9    | 303  | 97.2±1.20 | 100.6±1.70 | 103.6±1.20 |
| Year    |     |     |      |      |      | -      | -      | **        |
| 2011-2012| 290 | 275 | 264  | 11   | 286  | 95.1±1.20 | 99.2±1.70 | 104.3±1.20 |
| 2012-2013| 297 | 283 | 260  | 23   | 306  | 95.2±1.20 | 103.1±1.70 | 108.3±1.20 |
| 2013-2014| 306 | 296 | 288  | 8    | 304  | 96.5±1.10 | 98.9±1.60 | 102.4±1.20 |
| 2014-2015| 335 | 323 | 315  | 8    | 331  | 96.3±1.10 | 98.9±1.60 | 102.6±1.10 |
| 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
* 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      |
| Ulas      | 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|
| Ulas      | 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±0.04a| 271 | 19.14±0.47a| 268 | 28.08±0.57a|
| 2013      | 306 | 3.41±0.03b| 288 | 22.41±0.35b| 283 | 30.00±0.43b|
| 2014      | 304 | 3.48±0.05b| 294 | 22.78±0.53b| 293 | 30.88±0.63b|
| 2015      | 331 | 3.32±0.05c| 316 | 21.75±0.54c| 312 | 32.40±0.63c|
| 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|     |         |     |          |     |           |

F: Farm, DA: Dam Age, BY: Birth Year, G: Gender, BT: Birth Type, - P>0.05, * P<0.05, *** P<0.001

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 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<sup>a</sup> | 48 42.59±0.95<sup>a</sup> | 164 1.91±0.03<sup>a</sup> | 48 2.86±0.10<sup>a</sup> |
| 2.5            | 206 40.50±0.23<sup>b</sup> | 26 63.29±0.99<sup>b</sup> | 206 2.03±0.03<sup>b</sup> | 26 3.46±0.11<sup>b</sup> |
| 3.5            | 229 42.60±0.22<sup>c</sup> | 18 69.72±1.15<sup>c</sup> | 228 2.12±0.03<sup>c</sup> | 18 3.97±0.12<sup>c</sup> |
| 4.5            | 233 42.43±0.22<sup>c</sup> | 17 74.99±1.23<sup>d</sup> | 230 2.14±0.03<sup>d</sup> | 17 3.65±0.13<sup>d</sup> |
| 5.5            | 248 42.01±0.22<sup>c</sup> | 248 2.03±0.02<sup>b</sup> |                       |                 |
| 6≥             | 240 41.29±0.24<sup>bc</sup> | 237 2.00±0.03<sup>b</sup> |                       |                 |
| Year           |                           |                      |                       |
| 2012           | 329 39.59±0.19<sup>a</sup> | 18 57.96±1.15<sup>a</sup> | 329 1.99±0.02<sup>a</sup> | 18 3.23±0.12<sup>a</sup> |
| 2013           | 328 40.82±0.18<sup>b</sup> | 29 62.31±1.09<sup>b</sup> | 327 2.05±0.02<sup>b</sup> | 29 3.24±0.12<sup>b</sup> |
| 2014           | 331 40.44±0.20<sup>b</sup> | 31 63.52±1.12<sup>b</sup> | 327 1.97±0.02<sup>b</sup> | 31 3.70±0.12<sup>b</sup> |
| 2015           | 332 42.07±0.20<sup>c</sup> | 31 66.81±0.92<sup>c</sup> | 330 2.15±0.03<sup>c</sup> | 31 3.76±0.10<sup>c</sup> |

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
<sup>a, b, c, d</sup> 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    | 20 | 92.12±4.56<sup>a</sup> | 44  | 128 | 153.41±2.91<sup>a</sup> | 130 | 169 |
| 2     | 19 | 112.09±4.68<sup>b</sup> | 74  | 174 | 158.24±2.99<sup>b</sup> | 136 | 187 |
| 3     | 20 | 110.33±4.56<sup>b</sup> | 85  | 141 | 165.38±2.91<sup>b</sup> | 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 |

Interactions

| 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
<sup>a, b</sup> 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 | 45th day | 135th day | 45th day | 135th day | 45th day | 135th day |
|-------|---|----------|-----------|----------|-----------|----------|-----------|
|       |   | Udder width | Udder depth | Udder depth | Udder circumference | Udder width | Udder depth |
| 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±0.30b | 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  |   |           |            |           |            |           |            |
| Gulpınar | 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 |

** 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 weight 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 Gülünpar 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 Gülünpar 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 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.

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Conflict of Interest
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