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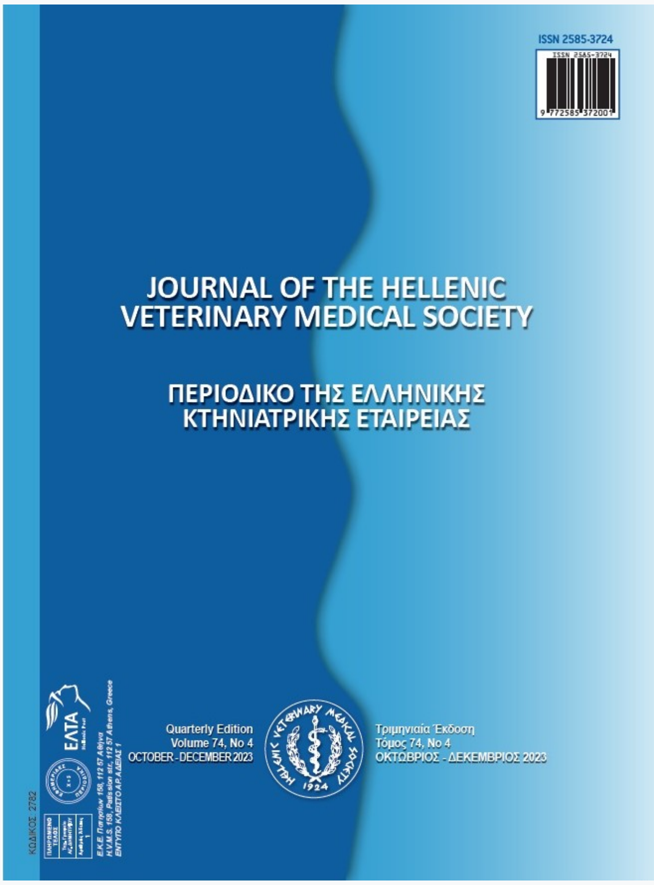

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Research article
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Live weights, body measurements, reproduction and fleece characteristics of Şavak Akkaraman ewes and rams

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ABSTRACT: The aim of this study was to examine some morphological and physiological characteristics of Şavak Akkaraman sheep and to determine the effects of some environmental factors on these traits. Data related to various characteristics of the Şavak Akkaraman sheep raised under traditional conditions, such as fertility parameters (n=538), live weight/body measurements (n=175), and fleece characteristics (n = 50), were collected from four different farms. The live weights of adult ewesand rams were 50.52 and 76.71kg, respectively. The body length of ewesand rams was 73.86 and 76.71 cm, wither height 73.63 and 79.41 cm, chest circumference 86.53 and 95.43 cm, rump height72.19 and 79.35 cm, and rump width 20.12 and 19.77 cm, respectively. The lambing rate was 0.94, fecundity and litter size were0.97 and 1.03, respectively, the number of weaning lambs per mating and lambing ewes were 0.90 and 0.95, respectively, and survival from birth to weaning time was calculated as 92%. Greasy fleece weight was 2.72 kg, percentage of clean wool 58.20%, Hauter and Barbe fiber length values were 31.98 and 43.01 mm, respectively, thinness was 30.50 µ, fiber elasticity was 30.16% and tensile strengthwas 26.85 cN/tex. In terms of these specific characteristics, Şavak Akkaraman sheep presentsome differences from other breeds and varieties of Akkaraman sheep. However, further detailed studies are necessaryto define thisvariety as a separate breed.

***Keywords*:** Sheep; live weight; body measurements; fertility; fleece

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INTRODUCTION

Raising sheep is not only an important livestock endeavor that provides society with products such as meat, milk, leather and wool, but it can also provide products at a lower cost than other livestock by taking advantage of low-quality feed and pasture (Yüceer et al., 2015). With approximately 35 million sheep (TUİK, 2019), Turkey comprises 2.9% of the world's sheep population (1.2 billion), and this number corresponds to approximately one third of the sheep stock of the European Union(99.3 million) (FAO, 2019). The total number of sheep in Turkey has increased by approximately 11 million in the recent decade (TUİK, 2019). The growing size of the herds of sheep makes even more important the improvement of productive parameters. An examination of the statistical data indicates that Turkey has an important advantage over European Union countries in particular in terms of sheep population (Yağcı et al., 2018).

Ninety-three percent of the sheep in Turkey are domestic breeds, most of which are fat-tailed sheep (MAF, 2019). The Akkaraman breed is fat-tailed and accounts for approximately 38% of Turkey's sheep population (MAF, 2019). There are several varieties of Akkaraman sheep, which are called Kangal Akkaraman, Karakaş sheep and Güney Karaman (Kaymakçı, 2013). In recent years, another variety that has received attention is the "Şavak Akkaraman Sheep" (Yağcı, 2017). Since 2011, the Şavak Akkaraman breed has been designated as a significant domestic genetic resource protected and supported by the Republic of Turkey Ministry of Agriculture and Forestry as part of the "National Domestic Animal Genetic Resources Conservation and Improvement Project". The Şavak Akkaraman sheep are raised extensively in the Munzur valley and the Upper Euphrates region in the provinces of Erzincan, Elazığ and Tunceli. There are approximately 500.000 head of Şavak Akkaraman sheep being raised in this region (MAF, 2019). Şavak Akkaraman sheep is originated from the Şavak Tribe that raises them (Yağcı, 2017). The Şavak Tribe are a semi-nomadic people group that make their living by raising sheep under traditional methods (Gültekin, 2013 and Yıldırım, 2003)

It is significant that the Şavak Akkaraman sheep are known for certain characteristics that distinguish them from the Akkaraman sheep and other varieties. Therefore, in order to define the breed and identify how it is different from other varieties, zoometric measurements, such as live weight and body measurements and economically significant traits such as survival rate, fertility and wool yield need to be identified. These characteristics demonstrate differences as an effect of different factors such as breed, sex, productivity and age (Akçapınar and Özbeyaz 1999; Akçapınar 2000).In addition to these characteristics, one of the fundamental factors that determines productivity in animal husbandry is fertility, which is economically significant (Erol et al. 2017). The most important indication of reproductive performance is the number of live offspring at weaning (Kaymakçı 2013). Another index of productivity is wool, which is a raw material in the textile and carpet industries evaluated through its thinness, durability, etc. The wool of Turkey's domestic sheep is generally mixed-coarse, and suitable for making carpets (Akçapınar 2000). In 2018, Turkey's sheep herds produced 58000 tons of wool (TUİK 2019).

Only a limited number of studies have been conducted on Şavak Akkaraman sheep (Yağcı et al. 2018), and these studies did not investigate their morphological and physiological characteristics. These characteristics should be determined and improved, since Şavak Akkaraman sheep is an important source of livelihood for the region.

The aim of this study was to examine some morphological and physiological characteristics of Şavak Akkaraman sheep such as live weight, body characteristics, fertility parameters and fleece productivity as well as certain wool characteristics and to determine the effects of some environmental factors on these traits.

MATERIAL AND METHODS

The animals used for the investigation consisted of sheep at four farms in the Tercan and Üzümlü districts of the province of Erzincan that took part in the genetic improvement of Şavak Akkaraman Sheep (General Directorate of Agricultural Research and Policies, GDAR) (project no: TAGEM/24SAV2011-01, TAGEM/24SAV2012-02). Some images of the animal material used in the study are presented in Figure 1 (a, b) and 2 (a, b, c).

They were used 538 sheep to identify fertility characteristics, 175 sheep (115 ewes and 60 rams) for live weight and body measurements in adult sheep, and 50 for fleece characteristics. Sheep are usually grazed on pastures, but they are kept in the barn by being fed with green hay and crushed barley during

Figure1a. Şavak Akkaraman ewe

Figure1b. Şavak Akkaraman ewe

Figure2a. Şavak Akkaraman ram

Figure 2b. Şavak Akkaraman ram

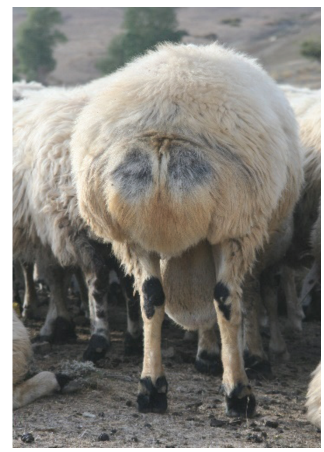

Figure 2c. Şavak Akkaraman ram

the winter months. Live weights were measured with a precision scale with an accuracy ±10 g and body measurements were performed using a measuring stave, tape measure. Birth records were used in the study to determine reproductive characteristics. The studied characteristics were calculated using the same methodology as Kaymakçı (2013).

Some of the criteria are provided below.

Fertility (Lambing rate) = Lambing Ewes/Mating Ewes

Fecundity or Prolificity (litter size) =Number of Born Lamb/ Number of Mating Ewes or Lambing Ewes

Survival rate (%) = Number of Lambs at Weaning/ Number of Lambs Born

Number of Lambs Per Mating Ewe or Lambing Ewe = Number of Lambs Born / Number of Ewes Productivity = Total Lamb Weight at Birth or Weaning / Number of Mating Ewes or Lambing Ewes

Wool samples sufficient for analysis were collected from the rump and rib areas of the fleece of each sheep with the shearing scissors from the skin surface. The weight of the greasy fleece after shearing was determined using a scale with an accuracy of ±10 grams. The wool analysis was conducted at the International Livestock Research and Training Center Directorate's Wool Mohair Laboratory. The fleeces were analyzed for length (Barbe and Hauter), thinness, elasticity, tensile strength and yield.Uster AL100-FL100 (Almeter AL 100, Fibroliner FL 100) device was used for length analysis, OFDA 100 (Optical Fiber Diameter Analyzer) device for thinness analysis, "Single Fiber Tensile Tester" Fafegraph ME devices were used for elasticity and strength analysis.

The raw data sets created from the collected data were subjected to variance analysis. The Generalized Linear Model (GLM) procedure was adopted for the variance analysis of live weights, body measurements, and fleece weights and calculated with the Least Square Means (LSM).The Duncan test was used to determine the significant differences between group means. For this purpose, the statistical model employed is the following:

For fertility: $Y_{ijl}=\mu+a_i+b_j+e_{ijl}$

For live body weight; $Y_{ijls}=\mu+a_i+b_j+r_1(X-)+e_{ijs}$

The regression coefficient, namely the $r_1(X-)$ for live body weight, was removed from the aforementioned formula in the analysis of body weights for ewes and rams.

For greasy fleece weight: $Y_{ios}=\mu+a_i+g_o+e_{ios}$

The region factor (g_o) for where the fleece came from was removed from the formula given above in the analysis of the greasy fleece weight.

For all mathematical models where; *Y*= dependent variables (fertility,live body weight and grease fleece weight); *a, b* and *c*= independent variable for age, farm, sex respectively. *e* was the random residual.All analysis was conducted in SPSS (2002).

RESULTS

Live weights and body measurements of ewe and ram

Variance analysis results and least square means for the live weights and body measurements of Şavak Akkaraman ewes and rams are shown in Table 1a, 1b and Table 2. Regarding live weight, age was found to be significant in rams and the farm factor significant in both sexes (P<0.01).

Age was a significant factor in terms of body length (BL) in both sexes, and it was significant in ewes in terms of tail length (TL) (P<0.01) and chest depth (CD) (P<0.05). The farm factor generally had a significant effect on body measurements in both sexes (P<0.01). Regression of live weight to body measurements was significant in both rams and ewes (except for head width (HW) and ear length (EL)) (Tables 1a, 1b and 2).

Reproductive performance

Reproduction characteristics and survival rates for Şavak Akkaraman sheep were categorized by age and farm and provided in Table 3.

The average lambing rate (fertility) was 0.94. While all of the sheep mating in the ram were lambed in some farms, the rate of sheep that could not be lambed reached 11% in others. There were significant differences amongfarms, especially in terms of survival rate. In a farm, there were no lamb mortal-

Table 1a. Live weights and body measurements in Şavak Akkaraman ewes

	n	LW (kg) $\bar{x} \pm S_{\bar{x}}$	BL (cm) $\bar{x} \pm S_{\bar{x}}$	WH (cm) $\bar{x} \pm S_{\bar{x}}$	CC (cm) $\bar{x} \pm S_{\bar{x}}$	CD (cm) $\bar{x} \pm S_{\bar{x}}$	CW (cm) $\bar{x} \pm S_{\bar{x}}$	RH (cm) $\bar{x} \pm S_{\bar{x}}$	RW (cm) $\bar{x} \pm S_{\bar{x}}$
Means	115	50.52±0.64	73.26±0.45	73.47±0.36	86.44±0.62	37.50±0.28	20.33±0.18	72.02±0.33	19.97±0.16
Ages		(P=0.147)	(P=0.007)	(P=0.342)	(P=0.657)	(P=0.048)	(P=0.462)	(P=0.33)	(P=0.135)
1	12	48.02±1.88	71.11±1.35^{c}	73.05±1.06	84.11±1.86	36.01±0.83^{cd}	19.71±0.54	72.34±0.99	20.22±0.47
2	3	49.43±3.27	67.71±2.33^{d}	71.91±1.84	86.12±3.21	34.91±1.43^{d}	20.69±0.94	70.32±1.70	18.35±0.81
3	21	48.19±1.21	71.91±0.88^{bc}	72.22±0.69	85.12±1.21	36.58±0.54^{bcd}	20.12±0.35	71.40±0.64	19.67±0.31
4	16	50.51±1,46	75.66±1.04^{a}	72.47±0.82	87.73±1.43	37.32±0.64^{bc}	19.98±0.42	70.44±0.76	20.52±0.36
5	17	49.24±1.54	75.16±1.10^{ab}	74.29±0.87	85.94±1.52	37.85±0.67^{bc}	20.69±0.44	73.13±0.80	20.84±0.38
6	17	52.90±1.45	75.35±1.04^{ab}	74.03±0.82	87.05±1.44	37.69±0.64^{bc}	20.42±0.42	73.37±0.76	20.08±0.36
7	16	53.20±1.46	73.09±1.06^{abc}	74.39±0.83	88.50±1.46	38.71±0.65^{ab}	20.98±0.43	73.40±0.77	20.09±0.37
8	7	53.40±2.38	74.84±1.70^{ab}	75.09±1.34	85.93±2.34	39.98±1.04^{a}	20.95±0.68	72.48±1.24	20.02±0.59
9	6	50.79±2.29	74.48±1.63^{abc}	73.77±1.28	87.46±2.25	38.48±1.00^{ab}	19.47±0.66	71.33±1.19	19.92±0.57
Farms		(P=0.001)	(P=0.000)	(P=0.114)	(P=0.000)	(P=0.075)	(P=0.030)	(P=0.001)	(P=0.000)
1	30	46.76±1.22^{c}	79.76±0.90^{a}	74.47±0.71	88.27±1.24^{ab}	37.79±0.55	20.23±0.36^{b}	73.77±0.66^{a}	19.03±0.31^{c}
2	25	50.82±1.34^{b}	70.28±0.95^{b}	74.04±0.75	81.96±1.31^{c}	36.38±0.58	21.08±0.38^{ab}	72.70±0.70^{ab}	21.80±0.33^{a}
3	30	54.26±1.26^{a}	71.97±0.94^{b}	73.10±0.74	85.72±1.29^{b}	37.39±0.57	19.66±0.38^{b}	70.28±0.68^{c}	18.65±0.33^{c}
4	30	50.24±1.23^{bc}	71.02±0.87^{b}	72.26±0.69	89.81±1.21^{a}	38.45±0.54	20.36±0.35^{ab}	71.35±0.64^{bc}	20.38±0.31^{b}
Regression LW			(P=0.000)	(P=0.000)	(P=0.001)	(P=0.000)	(P=0.001)	(P=0.000)	(P=0.000)
Coefficient			0.412±0.070	0.199±0.055	0.332±0.097	0.174±0.043	0.100±0.028	0.247±0.051	0.128±0.024

(LW) Live weight, (BL) Body length, (WH) Withers height, (CC) Chest circumference, (CD) Chest depth, (CW) Chest width, (RH) Rump height, (RW) Rump width, (TL) Tail length, (FSC) Front shank circumference, (HL) Head length, (HW) Head width, (MC) Mouth circumference, (EL) Ear length, (EW) Ear width

$\bar{x} \pm S_{\bar{x}}$= least squares means ±standard error ity until weaning, while lamb loss exceeded 20% in another farm (Table 3). The average survival rate of Şavak Akkaraman lambs was determined to be 92±1 %. Survival rate was higher in female lambs than in male lambs (93% and 91% respectively).

The productivity calculated in the study show that, with the exception of WWL PLE, age is a significant factor (P<0.01) in the other groups. The farm factor was significant statistically in all the examined characteristics as measures of reproductive productivity (P<0.01). The farm with the lowest mean BWL PLE (3.87 kg) was also with the highest WWL PLE (18.03

Table 1b. Live weights and body measurements in Şavak Akkaraman ewes

	n	TL (cm) $\bar{x} \pm S_{\bar{x}}$	FSC (cm) $\bar{x} \pm S_{\bar{x}}$	HL (cm) $\bar{x} \pm S_{\bar{x}}$	HW (cm) $\bar{x} \pm S_{\bar{x}}$	MC (cm) $\bar{x} \pm S_{\bar{x}}$	EL (cm) $\bar{x} \pm S_{\bar{x}}$	EW (cm) $\bar{x} \pm S_{\bar{x}}$
Means	115	38.31±0.56	8.10±0.04	23.23±0.13	13.21±0.10	23.08±0.14	14.98±0.18	8.41±0.10
Ages		(P=0.009)	(P=0.455)	(P=0.077)	(P=0.337)	(P=0.995)	(P=0.396)	(P=0.802)
1	12	33.01±1.69[d]	7.90±0.11	22.72±0.39	13.04±0.31	23.12±0.43	14.64±0.54	8.69±0.29
2	3	36.04±2.91[cd]	7.97±0.19	23.22±0.67	13.24±0.54	22.75±0.74	15.43±0.93	8.60±0.50
3	21	39.71±1.10[abc]	8.18±0.07	22.62±0.25	13.48±0.20	23.25±0.28	14.85±0.35	8.53±0.19
4	16	36.61±1.30[bcd]	8.19±0.08	22.65±0.30	12.92±0.24	23.28±0.33	14.96±0.41	8.32±0.22
5	17	42.08±1.38[a]	8.07±0.09	23.61±0.32	13.17±0.25	23.05±0.35	15.51±0.44	8.42±0.24
6	17	40.01±1.30[abc]	8.18±0.08	23.41±0.30	13.30±0.24	22.94±0.33	15.10±0.42	8.47±0.22
7	16	40.99±1.32[ab]	8.15±0.08	23.13±0.31	13.21±0.24	23.13±0.34	14.19±0.42	8.07±0.23
8	7	37.21±2.12[bcd]	8.11±0.14	23.82±0.49	13.87±0.39	22.94±0.54	15.78±0.68	8.46±0.37
9	6	39.15±2.04[abc]	8.10±0.13	23.89±0.47	12.69±0.38	23.28±0.52	14.39±0.65	8.09±0.35
Farms		(P=0.013)	(P=0.000)	(P=0.000)	(P=0.000)	(P=0.000)	(P=0.092)	(P=0.018)
1	30	39.42±1.13[a]	8.40±0.07[a]	24.23±0.26[a]	13.41±0.21[b]	23.73±0.29[a]	15.44±0.36	8.71±0.19[a]
2	25	36.86±1.19[b]	7.80±0.08[c]	21.16±0.28[c]	11.84±0.22[c]	22.00±0.30[b]	14.78±0.38	8.09±0.21[b]
3	30	35.82±1.17[b]	8.14±0.07[b]	24.01±0.27[ab]	14.21±0.22[a]	23.40±0.30[a]	15.40±0.37	8.71±0.20[a]
4	30	41.16±1.09[a]	8.04±0.07[b]	23.52±0.25[b]	13.39±0.20[b]	23.20±0.28[a]	14.32±0.35	8.11±0.19[b]
Regression LW		(P=0.003)	(P=0.046)	(P=0.002)	(P=0.299)	(P=0.023)	(P=0.549)	(P=0.050)
Coefficient		0.266±0.088	0.011±0.006	0.065±0.020	0.017±0.016	0.051±0.022	0.017±0.028	0.030±0.015

Table 2. Live weights and body measurements in Şavak Akkaraman rams

	n	LW (kg) $\bar{x} \pm S_{\bar{x}}$	BL (cm) $\bar{x} \pm S_{\bar{x}}$	WH (cm) $\bar{x} \pm S_{\bar{x}}$	CC (cm) $\bar{x} \pm S_{\bar{x}}$	RH (cm) $\bar{x} \pm S_{\bar{x}}$	RW (cm) $\bar{x} \pm S_{\bar{x}}$
Means	60	76.71±1.35	77.22±0.53	79.41±0.55	95.43±0.57	79.35±0.51	19.77±0.20
Ages		(P=0.000)	(P=0.007)	(P=0.317)	(P=0.662)	(P=0.135)	(P=0.391)
2	21	61.17±1.80[c]	75.94±0.87[b]	78.85±0.90	96.07±0.94	79.33±0.83	20.22±0.32
3	16	76.25±1.98[b]	78.76±0.74[a]	80.23±0.76	95.51±0.80	80.20±0.71	19.80±0.27
4	11	82.29±2.47[ab]	79.44±1.02[a]	78.93±1.06	95.10±1.10	77.66±0.98	20.21±0.38
5	9	83.64±2.84[a]	75.18±1.17[b]	78.01±1.21	93.88±1.26	78.57±1.12	19.61±0.44
6	3	80.20±4.83[ab]	76.77±1.78[ab]	81.02±1.85	96.60±1.92	81.01±1.71	19.02±0.66
Farms		(P=0.000)	(P=0.000)	(P=0.012)	(P=0.003)	(P=0.048)	(P=0.000)
1	10	65.65±2.49[c]	81.68±0.96[a]	82.00±1.00[a]	92.54±1.04[d]	81.19±0.92[a]	22.08±0.36[a]
2	9	64.94±2.70[c]	71.38±1.05[c]	77.99±1.08[bc]	94.73±1.13[bcd]	77.58±1.00[b]	18.04±0.39[b]
3	10	83.69±2.78[a]	78.47±1.15[ab]	78.80±1.19[abc]	93.59±1.24[cd]	79.42±1.10[ab]	19.41±0.43[c]
4	11	73.30±2.64[b]	76.01±0.96[b]	77.02±1.00[c]	97.41±1.03[ab]	77.82±0.91[b]	19.57±0.36[c]
5	6	85.01±3.38[a]	76.52±1.37[b]	79.74±1.42[abc]	98.82±1.48[a]	79.19±1.32[ab]	20.09±0.51[c]
6	8	82.63±3.05[a]	78.79±1.21[ab]	80.66±1.26[ab]	96.27±1.31[abc]	80.76±1.16[a]	19.39±0.45[c]
7	6	80.75±3.48[ab]	77.67±1.32[b]	79.64±1.37[abc]	94.67±1.43[bcd]	79.53±1.27[ab]	19.81±0.49[c]
Regression LW			(P=0.000)	(P=0.003)	(P=0.000)	(P=0.001)	(P=0.000)
Coefficient			0.220±0.051	0.167±0.053	0.487±0.055	0.177±0.049	0.085±0.019

(LW) Live weight, (BL) Body length, (WH) Withers height, (CC) Chest circumference, (RH) Rump height, (RW) Rump width
$\bar{x} \pm S_{\bar{x}}$= least squares means ± standard error

Table 3. Reproduction traits and survival rates for Şavak Akkaraman sheep.

	n	FER $\bar{x}\pm S_{\bar{x}}$	FEC $\bar{x}\pm S_{\bar{x}}$	NWL PME $\bar{x}\pm S_{\bar{x}}$	n	LS $\bar{x}\pm S_{\bar{x}}$	NWL PLE $\bar{x}\pm S_{\bar{x}}$	SA (%) $\bar{x}\pm S_{\bar{x}}$
Means	538	0.94±0.01	0.97±0.01	0.90±0.02	505	1.03±0.01	0.95±0.01	92±1
Ages								
2	127	0.81±0.03	0.85±0.04	0.82±0.04	103	1.05±0.02	1.01±0.03	96±2
3	88	0.93±0.03	0.98±0.04	0.94±0.06	82	1.05±0.02	1.01±0.03	96±4
4	125	0.99±0.01	1.01±0.01	0.98±0.02	124	1.02±0.01	0.99±0.02	98±1
5	52	1.00±0.00	1.04±0.03	0.85±0.06	52	1.04±0.03	0.85±0.06	82±5
6	38	0.97±0.03	0.97±0.03	0.97±0.03	37	1.00±0.00	1.00±0.00	100±0
7	7	1.00±0.00	1.00±0.00	1.00±0.00	7	1.00±0.00	1.00±0.00	100±0
8	101	0.99±0.01	1.03±0.02	0.83±0.04	100	1.04±0.02	0.81±0.04	81±4
Farms								
1	137	0.92±0.02	0.96±0.03	0.75±0.04	126	1.04±0.02	0.82±0.04	79±4
2	198	0.96±0.01	0.99±0.02	0.96±0.02	190	1.04±0.01	1.01±0.02	97±1
3	80	1.00±0.00	1.05±0.02	1.05±0.02	80	1.05±0.02	1.05±0.02	100±0
4	123	0.89±0.03	0.89±0.03	0.85±0.03	109	1.01±0.01	0.95±0.02	94±2

FER: Fertility, FEC: Fecundity, NWL PME: Number ofWeaning Lamb Per Mating Ewes, LS: Litter Size, NWL PLE: Number of WeaningLamb Per Lambing Ewes, SA: Survival Ability, $\bar{x}\pm S_{\bar{x}}$= least squares means ± standard error.

Table 4. Productivity in Şavak Akkaraman sheep.

	n	BWL PLE (kg) $\bar{x}\pm S_{\bar{x}}$	n	WWL PLE (kg) $\bar{x}\pm S_{\bar{x}}$	n	BWL PME (kg) $\bar{x}\pm S_{\bar{x}}$	WWL PME (kg) $\bar{x}\pm S_{\bar{x}}$
Means	505	4.12±0.05	467	16.12±0.46	538	3.85±0.08	15.02±0.51
Ages		(P=0.007)		(P=0.824)		(P=0.000)	(P=0.000)
2	103	3.98±0.07^{bc}	99	15.57±0.67	127	3.18±0.10^{d}	12.34±0.67^{c}
3	82	4.21±0.09^{ab}	79	16.08±0.83	88	3.63±0.14^{c}	13.86±0.87^{bc}
4	124	4.13±0.08^{b}	121	16.55±0.70	125	4.22±0.12^{b}	17.06±0.77^{a}
5	52	4.22±0.11^{ab}	43	15.12±0.97	52	4.25±0.17^{b}	15.04±1.08^{abc}
6	37	4.12±0.73^{b}	37	16.98±1.14	38	3.67±0.20^{c}	15.17±1.26^{ab}
7	7	3.78±0.28^{c}	7	17.12±2.57	7	3.32±0.45^{cd}	15.24±2.87^{ab}
8	100	4.42±0.09^{a}	81	15.39±0.78	101	4.70±0.13^{a}	16.42±0.86^{ab}
Farms		(P=0.000)		(P=0.000)		(P=0.000)	(P=0.000)
1	126	4.30±0.09^{a}	100	14.95±0.84^{b}	137	3.77±0.14^{bc}	13.09±0.89^{b}
2	190	3.87±0.07^{b}	184	18.03±0.66^{a}	198	3.86±0.11^{b}	17.84±0.84^{a}
3	80	4.11±0.09^{a}	80	13.57±0.77^{b}	80	4.31±0.14^{a}	14.35±0.86^{b}
4	109	4.20±0.10^{a}	103	17.92±0.88^{a}	123	3.47±0.14^{c}	14.80±0.92^{b}

BWL PLE: Birth Weight of Lambs Per Lambing Ewes, WWL PLE: Weaning Weight of Lambs Per Lambing Ewes, BWL PME: Birth Weights of Lambs Per Mating Ewes, WWL PME: Weaning Weights of Lambs Per Mating Ewes
a, b, c, d: The difference between subgroups with the same letter is nonsignificant; those with different letters are significant (P<0.05), $\bar{x}\pm S_{\bar{x}}$= least squares means ± standard error

kg), and lambs gained approximately 14 kg in weight until weaning. However, in another farm where no lamb died, the weight of the lamb produced in the period until weaning was approximately 9.5 kg.Similar results were obtained for traits of PME. This situation showed that conditions in farms can change a lot over time. In approximately 62.2 days which is from birth to weaning the lambing ewes gained weight to their lambs about 12 kg.

Wool yield and fleece characteristics

The results of variance analysis regarding the greasy fleece yield of Şavak Akkaraman sheep and the wool characteristics, as well as the least square mean are summarized in Table 5.

Variation based on the age of the sheep was not significant in terms of greasy fleece yield, except ewes of 6 ages. The age of the sheep was a significant factor in terms of fleece yield (P<0.01) and thinness

Table 5. The least square mean, standard errors and significance test results for the characteristics of wool from Şavak Akkaraman sheep.

	n	Greasy fleece weight (kg)	n	Percentage of clean wool (%)	Hauter fiber length (mm)	Barbe fiber length (mm)	Thinness (micron)	Elasticity (%)	Tensile strenghth (cN/Tex)
		$\bar{x} \pm S_{\bar{x}}$		$\bar{x} \pm S_{\bar{x}}$	$\bar{x} \pm S_{\bar{x}}$	$\bar{x} \pm S_{\bar{x}}$	$\bar{x} \pm S_{\bar{x}}$	$\bar{x} \pm S_{\bar{x}}$	$\bar{x} \pm S_{\bar{x}}$
Means	50	2.72±0.14	100	58.20 ±1.20	31.98 ±1.09	43.01 ±1.55	30.50 ±0.54	30.16 ±0.71	26.85 ±1.16
Ages		(P=0.07)		(P=0.005)	(P=0.565)	(P=0.593)	(P=0.023)	(P=0.512)	(P=0.373)
2	8	3.05 ±0.31^{a}	16	57.66 ±2.72^{ab}	29.13 ±2.45	38.96 ±3.51	30.77 ±1.21^{ab}	29.80 ±1.61	29.44 ±2.61
3	14	3.00 ±0.23^{a}	28	57.48 ±2.06^{ab}	33.69 ±1.85	44.34 ±2.65	30.81 ±0.92^{ab}	31.92 ±1.22	27.44 ±1.98
4	12	3.09 ±0.25^{a}	24	50.31 ±2.22^{b}	31.04 ±2.00	42.62 ±2.86	28.16 ±0.99^{b}	30.66 ±1.32	26.95 ±2.13
5	12	2.84 ±0.25^{a}	24	60.24 ±2.22^{a}	31.55 ±2.00	41.31 ±2.86	28.72 ±0.99^{b}	28.81 ±1.32	22.98 ±2.13
6	4	1.64 ±0.44^{b}	8	65.31 ±3.84^{a}	34.48 ±3.47	47.80 ±4.96	34.06 ±1.72^{a}	29.60 ±2.28	27.49 ±3.70
Regions				(P=0.193)	(P=0.011)	(P=0.43)	(P=0.235)	(P=0.321)	(P=0.300)
Rib			50	59.63 ±1.62	29.42 ±1.46^{b}	40.13 ±2.09	29.92 ±0.72	29.51 ±0.96	25.76 ±1.56
Thigh			50	56.77 ±1.62	34.53 ±1.46^{a}	45.88 ±2.09	31.08 ±0.72	30.80 ±0.96	27.94 ±1.56

*: $p<0.05$, **: $P<0.01$, ns: nonsignificant, $\bar{x} \pm S_{\bar{x}}$= least squares means ± standard error

($P<0.05$), but had an insignificant effect on the other characteristics. The region from which the wool sample was taken did not affect characteristics other than Hauter length (Table 5).

DISCUSSION

Live weights and body measurements

Zoometric measurements obtained from the animals provide important information about growth and phenotype structure (Akçapınar and Özbeyaz 1999). They are also used to identify differences between breeds. Numerous studies have been conducted to describe populations of farm animals for the purpose of identifying differences in regional breeders and increase yields. The results of the research that has been conducted demonstrate that there are differences, especially in live weights and body measurements depending on the region, breed and environmental factors.

A limited number of studies have been conducted with Şavak Akkaraman sheep in the province of Erzincan, an important center for nomadic sheep breeders and the production of Tulum cheese. The average live weights (50.6 and 76.7 kg for ewes and rams respectively) were lower than the live weights reported by Aktaş (2011), 57 kg for adult ewes, Altıoğlu (2007) 69 kg and 89 kg for adults ewes and rams respectively, and Ünal et al. (2004), 53 kg for adult ewes, all of which were studies of Akkaraman sheep raised in different locations. Studies conducted on Karakaş sheep, a variety of Akkaraman sheep, found live weights of 45.4 kg (Gökdal et al. 2003) and 48.7 kg (Gökdal et al. 2000) for adult ewes, which is even lower than the live weights in our study. The live weights found in our study were lower than those reported for the Morkaraman breed (53.8 kg) (İnan 2017) and for the Awassi breed (55.1 kg) (Oflaz 2018). These comparisons support the view that breed, region and environmental factors are effective on body structure.

The differences in live weight values obtained in different studies are also apparent in body measurements. The body measurements obtained in our study were body length of 73 cm and 77 cm for ewes and rams respectively, which was higher than the values reported for Akkaraman sheep by Altıoğlu (2007), where ewes and rams were 66 cm and 71 cm respectively, and by Yıldız and Denk (2006), where ewes and rams were 60 cm and 65 cm respectively. Wither heights were 73 cm and 79 cm for ewes and rams respectively, which was lower than the values reported by Altıoğlu (2007), where ewes and rams were 73.4 cm and 85 cm respectively, and higher than those reported by Yıldız and Denk (2006), were ewes and rams were 61 cm and 69 cm respectively. Rump heights were 73 cm and 79 cm for ewes and rams respectively, which was lower than the values reported by Altıoğlu (2007), where ewes and rams were 73.4 cm and 84 cm respectively, and higher than those reported by Yıldız and Denk (2006), where ewes and rams were 61 cm and 61 cm respectively.

The body length and wither height averages obtained the study were higher than those reported by Gökdal et al. (2000) in their study of Karakaş ewes, a variety of Akkaraman sheep (body length 65 cm and wither height 69 cm). The body length value (75 cm) reported by Yımaz et al (2007) for Kangal sheep was higher than the findings of this study, while the height at withers (65 cm) and rump height (67 cm) values were lower than the findings of this study.

Apart from the values reported by Yıldız and Denk (2006), the average chest circumference obtained in this study was significantly smaller than the values reported for Akkaraman sheep (Altıoğlu 2007; Yalçın and Aktaş 1976), for Karakaş (Gökdal et al. 2003; 2000), and for Kangal (Yılmaz and Tekin 2007). The values reported by Karaca et al. (2009) for Karya and Çine Çaparı sheep and by Koncagül et al. (2013) for Zom sheep were higher than the values obtained in this study.

The chest depth identified in this study was 37.5 cm, which was higher than all of the findings reported for Akkaraman and its varieties (Altıoğlu 2007; Gökdal et al. 2003 and 2000; Yıldız and Denk 2006; Yılmaz et al. 2007).

Furthermore, regression of live weights to body measurements was significant in both sexes, which indicates that body measurements are a significant determinant of live weight. These results are thought to be the result of different breeds, how the animals are raised (nomadic livestock husbandry) and regional differences.

According to the results of this research; It can be said that Şavak Akkaraman sheep have a smaller size than Kangal Akkaraman sheep and larger body measurements than Karakaş and Awassi breeds, which are similar to Akkaraman sheep.

Reproduction performance and survival ability

In sheep farming, the important thing in reproductive performance is the number of lambs obtained per sheep in each lambing.Therefore, fertility is the most important yield consideration for breeders. Litter size, one of the reproductive performance criteria, was 103% in Şavak Akkaraman sheep, which was similar to what Yakan et al. (2012) reported for Akkaraman sheep (102.3%), Ülker et al. (2004) for Karakaş sheep (105%), and Tekerli et al. (2002) for Akkaraman sheep (106.6%). However, a study conducted on Akkaraman (Akçapınar et al. 1998) and and Kangal Akkaraman sheep (Örkiz et al. 1984) reported lamb yield values of 120% and 111.3% respectively, which are higher than the values found in our study. The lamb yield values found in studies conducted on Awassi (Oflaz 2018), Hamdani (Öztürk and Odabaşıoğlu 2011), Norduz (Ülker et al. 2004) and Akkaraman (Türkmen 2018) breeds (99%, 96%, 100% and 93.2%) were lower than the values found in our study. The differences found in these studies may be due to farm conditions and regional differences. The lambing rate (94%) reported in this study, on the other hand, was either lower or similar to that reported in other studies conducted on Akkaraman sheep;Akçapınar et al.(1998) (93.4%); Özbey and Akcan (2000) (85%); Tekerli et al. (2002) (80%); Türkmen(2018) (89.8%). The fertility results for Şavak Akkaraman sheep indicate that breeders obtained approximately one lamb for each ewe, which may be an attempt to keep twin births to a minimum. The reason for this may be due to the traditional mentality of the breeders that raise Şavak Akkaraman sheep who view milk for making cheese as more important than lambs.

The survival ability observed in Şavak Akkaraman sheep under breeder conditions was measured as 92%, which is lower than the values of 95.9%, 97.6% and 100% reported in Akkaraman sheep by Türkmen (2018), Yakan et al. (2012) and Tekerli et al. (2002), respectively, and higher than the value of 89.5% reported by Akçapınar et al. (1998). Survival ability was lower than the value of 96.4%reported by Oflaz (2018) but higher than the 88.8% reported by Yakan et al. (2012), both studies conducted on the Awassi breed. The differences in the results from research studies could be due to variation in the care, feed and farm conditions.

Wool yield and fleece traits

The greasy fleece weight obtained from Şavak Akkaraman sheep was (2.72 kg) which was higher than the values for Zom sheep (1.37 kg) (Karakoç 2018), Morkaraman sheep (1.41 kg) (İnan 2017), Dağlıç sheep (1.63 kg) (Bağkesen 2017), Akkaraman sheep (2.45, 1.81 and 2.18 kg respectively) (Ünal et al. 2004; Yıldız and Denk 2006; Çolakoğlu and Özbeyaz 1999), Kangal Akkaraman sheep (1.69 kg) (Garip et al. 2010), Hamdani sheep (2.41 kg), Karakaş sheep (1.8 kg) (Uzun 2008) and Karadi sheep (Zinalabidin 2017) (1.64 kg) high, but lower than the values reported for Awassi sheep (4.5 kg) (Uzun 2008) and Karacabey Merino sheep (4.9 kg) (Uzun 2008). These findings confirm that with the exception of the Karacabey Merino and Awassi breeds, Şavak Akkaraman sheep are significantly better than other breeds in terms of greasy fleece yield.

Fiber thinness is expressed as the diameter of a single fiber in micrometers, and is one of the most important characteristics in wool processing together with length. The fiber diameter found in this study was 30.5 µm, which is similar to the 30.17 µm reported by

Ünal et al. (2004) in Akkaraman sheep, but lower than the values of 35.2 µm and 36.7 µm reported by Erdoğan et al. (1999) and Altın and Vanlı (1993) respectively. The fiber diameter in our study was smaller than that reported for the following Akkaraman sheep varieties and some other sheep breeds: Norduz (35.5 µm), Karakaş (34.9 µm), Awassi (36.8 µm), Morkaraman (31.9 µm), Hamdani (34.2 µm) and Karadi (36.1 µm) (Uzun 2008; Zinalabidin 2017; Küçük et al. 2000; Baş et al. 1994). According to these results, our study suggests that in terms of fiber thinness, the wool from the Şavak Akkaraman sheep is more ideal for carpet-making than other Akkaraman sheep and some other sheep breeds.

The fiber length values were measured both as Hauter (31.98 mm) and Barbe (43.01 mm), which is shorter than the values reported by Ünal et al. (2004) in their study of Akkaraman sheep, namely (H: 39.3 mm, B: 50.6 mm). The values in this study were longer than those reported in a study on Kangal Akkaraman sheep (Garip et al. 2010) (H: 27.3 mm, B: 38.8 mm), and shorter than those reported by Bandırma sheep (Sezenler et al. 2014) (H: 32.5 mm, B: 45.7 mm). The Barbe length in Menemen sheep, another sheep variety, was 34.8 mm, which is lower than that found in our study (Peşmen 2012). In light of the fiber length and other characteristics found in this study, the fleece is within the limits that may be preferred in the carpet industry.

Another factor that receives a lot of attention when determining price in the wool market is percentage of clean wool. The percentage of clean wool obtained from Şavak Akkaraman sheep is 58.2%, which is lower than the range of 61.5%-69.3% reported in studies with Norduz, Karakaş, Awassi, Morkaraman and Zom breeds (İnan 2017; Karakoç 2018; Uzun 2008; Veziroğlu 2016). The percentage of clean wool in Şavak Akkaraman sheep may be lower because they are found in large herds and raised with nomadic livestock techniques.

Tensilestrength, which is described as the durability displayed by a single fiber subjected to various forces (Uzun 2008), was 26.85 cN/tex, which is higher than the 12.20 reported for Akkaraman (Ünal et al., 2004), 11.7 for Norduz, 11.4 for Karakaş and 13.9 for Awassi (Uzun 2008). In this study, the elasticity value, which is defined as the fiber's resistance to breakage (Uzun 2008), was 30.1%, which is higher than the 29.44 reported by Ünal et al.(2004) for Akkaraman sheep and 27.6 reported by Uzun (2008) for Karakaş sheep, but lower than the 30.8 and 32.6 reported by Uzun (2008) for Norduz and Awassi sheep respectively.

The differences between the values obtained in this study regarding fleece yield and wool traits for Şavak Akkaraman sheep and those found in the literature may be due to genotype, age, local conditions where the sheep are raised, and differences in care and nutrition.

CONCLUSIONS

This study describes certain morphological and physiological characteristics of Şavak Akkaraman sheep raised under traditional conditions. A comparison of the results obtained from research conducted on Akkaraman sheep, varieties of Akkaraman sheep and other sheep breeds, as well as the live weights, body measurements, reproduction, wool yield and traits for Akkaraman sheep has shown that there are differences among them. Şavak Akkaraman sheep can be defined as a variety with a slightly smaller size and a more delicate body structure. Reproductive performance, on the other hand, is quite good in spite of breeder conditions. It is thought that the yield levels identified in Şavak Akkaraman sheep could be raised by improving conditions related to nutrition and care. Şavak Akkaraman wool is classified as mixed-coarse based on fleece characteristics and has the traits of wool used for carpet.

Further studies to identify yield levels in Şavak Akkaraman sheep and improve yield characteristics will provide important data about how to protect domestic genetic resources. In this regard, it is important that the Şavak Akkaraman variety be made a priority in research on preserving genetic diversity and improving yield characteristics so that the ŞavakTribe can continue raising the breed and not abandon their operations.

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CONFLICT OF INTEREST

None declared by the authors.

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