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COMPARATIVE ANALYSIS OF VARIOUS FLEECE CHARACTERISTICS OF NORDUZ AND ZOM SHEEP

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ABSTRACT

This research aimed to evaluate the fleece samples obtained from the shoulder, rump and flank areas of Norduz and Zom sheep. The study consisted of 25 Norduz sheep and 24 Zom sheep. The longest hauteur fleece in Norduz and Zom sheep was obtained from the rump area (40.30±2.96 and 30.11±1.50 mm) and the longest barbe fleece was obtained from the rump area (58.22±4.70 and 42.28±3.10 mm). Upon examination of the fiber diameter of the fleece of the Norduz and Zom sheep, the thickest fleece was found in the rump area (35.73±1.13 and 33.01±0.86 µ), with the fleece in the other areas finer and closer together. In both breeds (Norduz and Zom), the fleece obtained from the flank had the highest elasticity (32.17±0.83 and 31.44±1.01%), and the fleece obtained from the rump had the highest strength (33.91±2.03 and 24.33±2.03 cN/tex). In both the Norduz and Zom sheep, the highest fleece yields were obtained from the flanks: 63.58±1.52 and 62.96±2.27%. This study revealed no marked variation in the fleece yields and characteristics of the Norduz and Zom sheep, which are thought to be a variety of the White Karaman sheep.

Key words: Sheep, Norduz, Zom, fleece characteristics.

INTRODUCTION

Turkey is one of the top ten sheep-producing countries in the world (FAO, 2015), with 31,507,934 head of sheep and 59,196 tons of fleece produced annually (TUIK, 2016).

Sheep breeding has long been common in the Eastern Anatolian region due to its relatively large pasture areas and suitable climate (Hasimoglu and Cakir, 1976). The Van province in the Eastern Anatolian region is the biggest sheep producer (2,456,493 head) and fleece manufacturer (3,815 tons) in Turkey (TUIK, 2016). Norduz sheep are reared on the Norduz plateau in the Gürpınar district of Van province. Zom sheep are reared in the Karacadağ region in the vicinity of the extinct Karacadağ volcano, which extends along the boundary of Şanliurfa and Diyarbakir (Koncagul *et al*., 2012).

The White Karaman breed accounts for 40% of Turkish sheep produced (Ertugrul *et al*., 2009). This breed has a large number of subtypes, and varieties, such as Karakaş (Sonmez, 1978), Norduz (Bingol, 1998; Tuncer and Cengiz, 2010), Kangal, South Karaman, Zom and Savak (Koncagul *et al*., 2012). There have been no studies of the fleece characteristics of Zom sheep and only a few studies of those of Norduz sheep.

The degree of inheritance of fleece characteristics, including the fleece yield, is high. The degree of inheritance of fleece yield in White Karaman sheep was reported to be 0.51 (Pekel, 1968). In many studies of Merino sheep, the degree of inheritance of fleece strength was from 0.23–0.47, and the degree of inheritance of fleece yield was from 0.46–0.72 (Safari and Fogarty, 2003). The degree of inheritance of the diameter of the fleece of sheep reared for meat production was reported to be 0.57, whereas that of the length of fleece was reported to be 0.48 (Safari *et al*., 2005).

The aim of this study was to determine the fleece characteristics, including the yield, of Zom sheep and compare them with those of Norduz sheep.

MATERIALS AND METHODS

The study consisted of 2- to 4-year-old Zom sheep (n = 24) reared in Alatosun village, which is located within the Diyarbakir boundaries of the Karacadağ region, and Norduz sheep (n = 25) at the Van Yuzuncu Yil University Research and Application Farm.

The animals' live weights (LWs) and the following fleece characteristics were investigated: greasy fleece weight (FW), shoulder fiber hauteur length (SFHL), shoulder fiber barbe length (SFBL), shoulder fiber diameter (SFD), shoulder fiber elasticity (SFE), shoulder fiber strength (SFS), shoulder fleece yield (SFY), rump fiber hauteur length (RFHL), rump fiber barbe length (RFBL), rump fiber diameter (RFD), rump fiber elasticity (RFE), rump fiber strength (RFS), rump fleece yield (RFY), flank fiber hauteur length (FFHL), flank fiber barbe length (FFBL), flank fiber diameter

(FFD), flank fiber elasticity (FFE), flank fiber strength (FFS) and flank fleece yield (FFY).

The greasy FW was measured using a scale sensitivity of 10 g. Using shearing scissors, fleece samples from 50 to 100 g were taken from the shoulder, flank and rump area of the animals, placed in paper bags and stored at room temperature. The post-shearing LW of each animal was measured with a field-type scale (with a sensitivity of 500 g).

The length, fiber diameter, elasticity, strength and yield of the samples were measured at the Lalahan International Center of Animal Husbandry Research and Education. The fleece length was measured in millimeters using the International Wool Textile Organization (IWTO-TM–17–859) analysis method using an USTER AL+FL 100 device. This method determines the fiber length by using the USTER FL 100 fiber straightener and the USTER AL 100 fiber length measure. Fibers with a length of 3 to 280 mm were found using a measurement sensitivity of 1%, and the number of fibers (hauteur), volume and weight of the fibers (barbe) were recorded (Aytac, 2004, Albrecht *et al*., 2002).

The fiber diameter (measured in micrometers) was determined using an Optical Fibre Diameter Analyser (OFDA 100).

Elasticity (%) and strength (cN/tex) analyses were tested using Fafegraph Single Fiber Tensile Tester devices.

The fiber strength was measured in cN/tex, which is the unit of strength preferred by the textile industry (the weight of 1 km of thread is approximately 1.0167 g) (Anonymous, 2016).

Statistical analysis: The two-factor variance analysis method was used to determine possible differences between the average genotypes with respect to the fleece characteristics. Correlation analysis was performed to determine relationships among the characteristics (Winer *et al*., 1991).

RESULTS

Fleece characteristics of the Norduz and Zom sheep: Table 1 presents the fleece characteristics of the Norduz and Zom sheep. The LW of the Zom sheep was slightly higher than that of the Norduz sheep, and the Zom sheep had a lower greasy FW. In both breeds, the longest fleece was obtained from the rump area, and the shortest fleece was obtained from the flank area. Upon examination of the fiber diameter of the fleece of both Norduz and Zom sheep, the thickest fleece was found in the rump area, with the fleece in the other areas finer and closer together. In both breeds, the fleece obtained from the flank had the highest elasticity, and the fleece obtained from the rump had the highest strength. In both the Norduz and Zom sheep, the highest fleece yields were obtained from the flanks.

Examining Table 1, the highest coefficients of change were observed in the FFS (40.78%) and RFBL (40.39%) properties of the Norduz sheep and FFS (42.85%) and RFS (40.85%) properties of the Zom sheep. The lowest coefficients of change were observed in the SFD (9.28%), RFE (10.46%) and FFD (10.87%) properties of the Norduz sheep and in the LW (8.88%), FFD (9.34%) and SFD (9.72%) properties of the Zom sheep.

Correlation coefficients: As a result of the correlation analyses, significant correlations were determined between some of the characteristics at $P<0.01$ significance level. The correlations between the LW and fleece characteristics of the Norduz sheep are shown in Table 2. There were strongly significant correlations between the SFHL value and SFBL, SFD, SFS, RFHL, RFBL, RFS, FFHL and FFS values. Significant positive relationships were also observed between SFD, SFE, SFS, RFHL, RFBL, RFS, FFHL, and FFBL values, in line with an increase in the SFBL. Significant positive relationships were observed between SFD and SFS, FFD and FFS, SFE and SFS, SFY and RFY, RFE and RFS, and RFS and FFBL values. Strongly significant correlations were observed between RFHL and RFBL, RFD, RFE, RFS, FFHL and FFBL values. Significant relationships were also observed between the RFBL value and RFD, RFE, RFS, FFHL and FFBL values. In addition, strongly significant correlations were observed between the RFD value and the FFD and FFY values.

The correlations between the LW and fleece characteristics of the Zom sheep are shown in Table 3. Increases in the SFHL were correlated with significant increases in the SFBL and FFY. Significant positive relationships were found between the SFBL and SFD, SFS, RFD and FFY. Increases in the SFD were correlated with significant changes in the SFS and FFD, and there were significant correlations between SFE and SFS. Increases in the SFS also led to increases in the FFD and FFS. Significant correlations were found between the RFHL and RFBL, RFD, RFE, and RFS. A change in the RFBL was associated with significant changes in RFD, RFE, and RFS values. The RFD showed correlation with RFS and FFD values, and very significant increases were observed between the RFS value and an increase in RFE. In addition, positive relationships were observed between the RFS, FFD and FFS values, and strongly significant correlations were observed between the FFHL and FFBL values. An increase in FFBL values was associated with significant increases in FFS values. Finally, significant correlations were observed between FFE and FFS.

Table 1. Live weight (LW) and various fleece characteristics of the Norduz and Zom sheep.

	Norduz				Zom			
	Mean	**CV (%)**	**Min.**	**Max.**	**Mean**	**CV (%)**	**Min.**	**Max.**
LW (kg)	50.63±1.59	15.74	39.20	71.60	52.13±0.94	8.88	43.60	60.70
FW (kg)	1.84±0.11	29.34	0.80	3.20	1.36±0.07	26.47	0.87	2.20
SFHL (mm)	33.08±1.78	26.87	21.20	65.90	29.78±1.20	19.74	21.50	44.00
SFBL (mm)	46.78±3.19	34.07	27.60	102.10	40.08±1.80	22.05	28.90	70.10
SFD (µ)	31.03±0.58	9.28	26.07	36.63	30.85±0.61	9.72	26.83	39.73
SFE (%)	31.85±0.74	11.83	20.73	37.74	30.53±0.95	15.29	22.68	38.86
SFS (Cn/tex)	29.36±2.07	35.21	11.83	48.33	24.11±1.74	35.29	12.70	43.42
SFY (%)	60.93±1.46	11.96	46.10	76.30	61.88±1.86	15.22	46.30	77.60
RFHL (mm)	40.30±2.96	36.67	22.70	75.10	30.11±1.50	24.34	22.70	55.10
RFBL (mm)	58.22±4.70	40.39	29.60	112.40	42.28±3.10	35.95	28.70	97.40
RFD (µ)	35.73±1.13	15.75	26.73	50.22	33.01±0.86	12.75	26.28	48.21
RFE (%)	31.63±0.66	10.46	25.84	37.46	30.44±1.16	18.72	20.30	39.32
RFS (Cn/tex)	33.91±2.03	29.96	17.09	52.59	24.33±2.03	40.85	10.89	53.14
RFY (%)	60.73±1.61	13.23	50.50	77.10	60.64±2.29	18.46	41.40	79.10
FFHL (mm)	30.29±1.59	26.18	21.30	60.90	28.28±0.92	15.87	20.50	36.20
FFBL (mm)	41.50±2.80	33.78	27.50	96.10	37.71±1.40	18.16	26.90	53.30
FFD (µ)	31.90±0.69	10.87	27.04	41.85	30.28±0.58	9.34	25.03	37.51
FFE (%)	32.17±0.83	12.90	21.57	39.49	31.44±1.01	15.71	20.67	39.59
FFS (Cn/tex)	31.58±2.58	40.78	14.91	75.05	21.77±1.88	42.25	12.70	47.01
FFY (%)	63.58±1.52	11.96	50.70	80.50	62.96±2.27	17.69	44.20	84.20

LW: Live weight, FW: Fleece weight, SFHL: Shoulder fiber hauteur length, SFBL: Shoulder fiber barbe length, SFD: Shoulder fiber diameter, SFE: Shoulder fiber elasticity, SFS: Shoulder fiber elasticity, SFS: Shoulder fiber strength, SFY: Shoulder fleece yield, RFHL: Rump fiber hauteur length, RFBL: Rump fiber barbe length, RFD: Rump fiber diameter, RFE: Rump fiber elasticity, RFS: Rump fiber strength, RFY: Rump fleece yield, FFHL: Flank fiber hauteur length, FFBL: Flank fiber barbe length, FFD: Flank fiber diameter, FFE: Flank fiber elasticity, FFS: Flank fiber strength, FFY: Flank fleece yield.
CV : Coefficient of variation.
Min.: Minimum, Max.: Maximum.

Table 2. The correlations among the live weight (LW) and fleece characteristics of the Norduz sheep.

	LW	FW	SFHL	SFBL	SFD	SFE	SFS	SFY	RFHL	RFBL	RFD	RFE	RFS	RFY	FFHL	FFBL	FFD	FFE	FFS	FFY
LW	1	.35	.39	.43*	.43*	.06	.39	.17	.50*	.47*	.36	.03	.26	.03	.12	.20	.17	.39	.46	-.31
FW		1	.34	.42*	-.04	.36	.49*	.46*	.40*	.42*	.02	.34	.39	.38	.06	-.16	.26	.30	.47*	.13
SFHL			1	.98**	.56**	.48*	.54**	.41*	.60**	.64**	.31	.36	.62**	.22	.66**	.74**	.23	.38	.54**	-.15
SFBL				1	.53**	.55**	.58**	.50*	.64**	.68**	.30	.45*	.66**	.24	.61**	.72**	.20	.41*	.57	-.16
SFD					1	.45*	.57**	.07	.38	.42*	.47*	.05	.49*	.09	.16	.22	.64**	.30	.54**	-.40
SFE						1	.67**	.46*	.25	.30	.08	.36	.43*	.41*	.15	.22	.01	.23	.36	.01
SFS							1	.26	.42*	.42*	.26	.32	.54*	.09	.32	.37	.17	.43*	.76**	-.23
SFY								1	.19	.17	-.09	.38	.13	.54**	.15	.22	-.21	.50*	.32	.41*
RFHL									1	.98**	.75**	.53**	.74**	-.03	.65**	.75**	.41*	.31	.41*	-.48*
RFBL										1	.71**	.55**	.81**	-.01	.62**	.73**	.42*	.26	.37	-.49*
RFD											1	0.25	.59*	-.24	.36	.43*	.60**	.10	.20	.51**
RFE												1	.61**	.30	.48*	.47*	.10	.17	.16	-.10
RFS													1	.06	.47*	.53**	.32	.34	.39	-.36
RFY														1	-.12	-.12	-.16	.00	.11	.36
FFHL															1	.96**	.35	.18	.30	-.26
FFBL																1	.32	.23	.35	-.34
FFD																	1	-.07	.27	-.40*
FFE																		1	.61**	-.08
FFS																			1	-.19
FFY																				1

*: P<0.05, **: P<0.01

LW: Live weight, FW: Fleece weight, SFHL: Shoulder fiber hauteur length, SFBL: Shoulder fiber barbe length, SFD: Shoulder fiber diameter, SFE: Shoulder fiber elasticity, SFS: Shoulder fiber elasticity, SFS: Shoulder fiber strength, SFY: Shoulder fleece yield, RFHL: Rump fiber hauteur length, RFBL: Rump fiber barbe length, RFD: Rump fiber diameter, RFE: Rump fiber elasticity, RFS: Rump fiber strength, RFY: Rump fleece yield, FFHL: Flank fiber hauteur length, FFBL: Flank fiber barbe length, FFD: Flank fiber diameter, FFE: Flank fiber elasticity, FFS: Flank fiber strength, FFY: Flank fleece yield.

Table 3. The correlations among the live weight (LW) and fleece characteristics of the Zom sheep.

	LW	FW	SFHL	SFBL	SFD	SFE	SFS	SFY	RFHL	RFBL	RFD	RFE	RFS	RFY	FFHL	FFBL	FFD	FFE	FFS	FFY
LW	1	.23	-.13	-.09	.13	.30	.25	-.36	.15	.13	-.08	.01	.14	-.17	.02	.05	.17	.44	-.27	-.23
FW		1	.01	-.04	.19	.08	.33	-.32	.08	.04	-.12	.04	-.09	-.03	.15	-.29	.17	-.18	-.01	-.05
SFHL			1	.92**	.47*	.25	.49*	.03	.20	.15	.32	.29	.23	.21	.15	.23	.24	.02	.27	.55**
SFBL				1	.67**	.39	.64**	.03	.33	.32	.59**	.26	.44*	.15	.30	.41*	.45*	.12	-.46*	.59**
SFD					1	.37	.80**	-.27	.21	.23	.65**	.14	.47*	.14	.34	.43*	.72**	.27	.59*	-.34
SFE						1	.57**	-.12	.08	.13	.23	.14	.17	.04	.23	.33	.21	.51*	.49*	.36
SFS							1	-.40	.16	.14	.50*	.16	.42*	.09	.13	.20	.62**	.18	.55**	.40
SFY								1	.05	-.02	.01	.11	.06	.54*	-.24	-.17	-.22	-.04	-.34	.41*
RFHL									1	.97**	.52**	.60**	.69**	-.08	-.09	.02	.34	.16	.22	.06
RFBL										1	.55**	.55**	.66**	-.19	.04	.14	.36	.18	.27	.03
RFD											1	.26	.75**	-.12	.37	.48*	.82**	.16	.51*	.27
RFE												1	.52**	.07	-.13	.05	.16	.20	.19	-.04
RFS													1	.00	.04	.23	.56**	.29	.60**	.18
RFY														1	-.34	-.36	-.11	-.10	-.22	.49*
FFHL															1	.93**	.40	.33	.46*	.08
FFBL																1	.43*	.49*	.63**	.15
FFD																	1	.20	.48*	.07
FFE																		1	.57**	.14
FFS																			1	.09
FFY																				1

*: P<0.05, **: P<0.01

LW: Live weight, FW: Fleece weight, SFHL: Shoulder fiber hauteur length, SFBL: Shoulder fiber barbe length, SFD: Shoulder fiber diameter, SFE: Shoulder fiber elasticity, SFS: Shoulder fiber elasticity, SFS: Shoulder fiber strength, SFY: Shoulder fleece yield, RFHL: Rump fiber hauteur length, RFBL: Rump fiber barbe length, RFD: Rump fiber diameter, RFE: Rump fiber elasticity, RFS: Rump fiber strength, RFY: Rump fleece yield, FFHL: Flank fiber hauteur length, FFBL: Flank fiber barbe length, FFD: Flank fiber diameter, FFE: Flank fiber elasticity, FFS: Flank fiber strength, FFY: Flank fleece yield.

DISCUSSION

In this study, the average LW of the Norduz and Zom sheep was 50.63 kg and 52.13 kg, respectively. A comparison of these values with those of other breeds in the same region - some of which are purported to be related to Norduz and Zom sheep (Tuncer and Cengiz, 2010; Koncagül *et al*., 2012) - showed that these values were lower than those of White Karaman (Colakoglu and Ozbeyaz, 1999), similar to those of White Karaman sheep (Unal *et al*., 2004), and higher than those of Karakaş (Gokdal *et al*., 2000) and Zom (Koncagul *et al*., 2012) sheep. The LW of the Norduz sheep was lower than the value reported for Awassi, whereas the LW of the Zom sheep was similar to that recorded for Awassi (Tabbaa *et al*., 2001).

The FW of the Norduz sheep was 1.84 kg whereas that of the Zom sheep was 1.36 kg. The FW of the Norduz sheep was higher, and that of the Zom sheep was lower, than the FW value reported for Red Karaman sheep (Ulusan, 1995). Some previous studies reported that the FW of Norduz and Zom sheep was lower than the FW of White Karaman sheep (Colakoğlu and Ozbeyaz, 1999; Aytac, 2004; Unal *et al*., 2004; Tuncer and Cengiz, 2010), whereas others reported that the FW of Norduz sheep was similar (Yildiz and Denk, 2006) or higher (Elibol and Dag, 2004) to that of White Karaman sheep. Studies also found that the FW of Norduz sheep was similar to (Gokdal *et al*., 2000), or slightly higher (Karakus *et al*., 2005) than that of Karakaş sheep. In this study, the FW of the Norduz and Zom sheep was lower than that of Awassi (Tabbaa *et al*., 2001) and Norduz (Karakus *et al*., 2005) sheep. The FW of the Norduz sheep was higher than that of Arabi sheep breeds (Taherpour *et al*., 2012), whereas the FW of the Zom sheep was lower.

Usually, studies of the length, fiber diameter, elasticity, strength and yield characteristics of fleeces are based on samples taken from the flank area. In this study, samples were obtained from three areas: shoulder, rump and flank. Thus, the comparison of the results of this study with those of other studies is limited to values pertaining to fleece samples taken from the flank.

In this study, the SFHL, RFHL and FFHL values of Norduz sheep were 33.08 mm, 40.30 mm and 30.29 mm, respectively, and they were 29.78 mm, 30.11mm, and 28.28 mm, respectively, for Zom sheep. Of these values, the Norduz RFHL was similar (Unal *et al*., 2004) or higher (Aytac, 2004) than the hauteur length reported for White Karaman sheep. On the other hand, all the other values were lower than those reported for White Karaman sheep. The FFHL of the Norduz, and the RFHL and the SFHL of the Zom sheep, were fairly similar to those reported for the hauteur length for the Norduz sheep (Tuncer and Cengiz, 2010). The Norduz FFHL was lower, whereas the Norduz SFHL was similar to that reported for the Karakaş sheep (Tuncer and Cengiz, 2010). The Norduz RFHL was higher than that reported for Karakaş. The hauteur lengths for all areas of the Zom sheep were lower than the values reported for Karakaş. The hauteur length in the Norduz sheep was similar to that reported for Arabi sheep (Taherpour *et al*., 2012), whereas the hauteur length of the Zom sheep was lower than the value reported for the Arabi breed.

The SFBL, RFBL and FFBL values of the Norduz sheep in this study were 46.78 mm, 58.22 mm, and 41.50 mm, respectively, and those of the Zom sheep were 40.08 mm, 42.28 mm and 37.71 mm, respectively. Of these values, the Norduz RFBL was similar to the barbe length of White Karaman sheep (Aytac, 2004), whereas the SFBL and FFBL of the Norduz sheep, and all of the barbe lengths of Zom sheep, were lower than those of White Karaman sheep. Although the Norduz RFBL was higher than the barbe length documented in another study of White Karaman sheep (Unal *et al*., 2004), the SFBL and FFBL of Norduz sheep, and all of the barbe length values of Zom sheep, were lower than the values reported by Unal *et al*. (2004). The Norduz SFBL was similar to the barbe length reported previously for Norduz sheep, but the Norduz RFBL was higher. The Norduz RFBL was similar to the value reported previously for Karakaş sheep (Tuncer and Cengiz, 2010). The FFBL of the Norduz, and all of the barbe length of the Zom sheep, were lower than Norduz and Karakaş breeds (Tuncer and Cengiz, 2010). In addition, the barbe lengths of Norduz and Zom sheep were lower than those of Arabi sheep breeds (Taherpour *et al*., 2012).

In this study, the SFD, RFD, and FFD values of the Norduz sheep were 31.03 µm, 35.73 µm, and 31.90 µm, respectively, whereas those of the Zom sheep were 30.85 µm, 33.01 µm, and 30.28 µm, respectively. These values were higher than the fiber diameter reported for White Karaman sheep (Aytac, 2004). The RFD values of the Norduz and Zom sheep were higher than those reported earlier for White Karaman (Unal *et al*., 2004), Norduz and Karakaş sheep, but the fiber diameters for all the other sampled areas were similar to the values reported in other the literature (Tuncer and Cengiz, 2010) . The average fiber diameter of the Norduz and Zom sheep was thinner than the fiber diameter of Middle Eastern sheep breeds, such as Ossimi (Maria *et al*., 1992), Barbary (Akraim *et al*., 2008), Awassi (Tabbaa *et al*., 2001), Afshari and Mehrabani (Ansari-Renani, 2012), but similar to those reported for Barbary, Black of Thibar (Harizi and Abidi, 2015), Zandi, Lori, and Baluchi (Ansari-Renani, 2012).

As shown by these results, the SFE, RFE, and FFE values of the Norduz sheep were 31.85%, 31.63%, and 32.17%, respectively, and those of the Zom sheep were 30.53%, 30.44%, and 31.44%, respectively. These values were similar to those reported for Red Karaman sheep (Kucuk *et al*., 2000) and similar to (Unal *et al*.,

2004), or higher (Arik *et al*., 2003; Aytac, 2004) than those reported in some studies of White Karaman sheep. These values were lower than those reported elsewhere for Norduz and Karakaş sheep (Tuncer and Cengiz, 2010).

In this study study, the SFS, RFS, and FFS values of the Norduz sheep were 29.36, 33.91, and 31.58 cN/tex, respectively, whereas those of the Zom sheep were 24.11, 24.33, and 21.77 cN/tex, respectively. These values were higher than the strength values reported for Kangal White Karaman (Garip *et al*., 2010). The fleece strength of Norduz sheep was reported to be similar to that of Romney sheep (Wuliji *et al*., 2011), whereas that of Zom sheep was reported to be lower.

The SFY, RFY, and FFY values of the Norduz sheep in this study were 60.93%, 60.73%, and 63.58%, respectively, and those of the Zom sheep were 61.88%, 60.64%, and 62.96%, respectively. These values were similar to (Arik *et al*., 2003), or lower (Aytac, 2004) than those reported for White Karaman, and similar to those reported for Kangal White Karaman (Garip *et al*., 2010) and Karakaş, but higher than those reported for Norduz (Tuncer and Cengiz, 2010). The fleece yield of the Norduz and Zom sheep was lower than the value reported for Omani sheep (Mahgoub *et al*., 2010).

The comparison of the LW and fleece characteristics of the Norduz and Zom sheep revealed that the Zom sheep had a slightly higher LW, lower greasy FW and thinner fiber diameter in all areas (shoulder, rump, and flank). The most apparent differences were observed in the length (hauteur and barbe) and strength values, with the Norduz sheep exhibiting higher values with respect to these characteristics. The highest fiber diameter and the longest fleece were observed in the rump area in both the Norduz and Zom sheep. The lowest rate of elasticity was also found in the rump area in both breeds. This result is compatible with those that reported in other the literature (Altin *et al*., 1998; Kucuk *et al*., 2000), which found that the strength increased and the elasticity decreased with an increased fiber diameter. In the analysis of the fleece yield of the Norduz and Zom sheep, the cleanest fleece was found in the flank, and the least clean was found in the rump, a finding compatible with the literature (Kuçuk *et al*., 2000).

Breeds, such as the Norduz and Zom sheep, that diversify as a result of changes in climate and geographical conditions are important ecological assets of the regions in which they are reared (Ertugrul *et al*., 2009). This study revealed no marked variation in the fleece yields and characteristics of the Norduz and Zom sheep, which are thought to be varieties of the White Karaman sheep.

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