Milk Yield Characteristics of Norduz Sheep

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SUMMARY

The aim of the study was to investigate milk yield and milk composition of Norduz sheep reported as a type within Akkaraman breed. The study was conducted on 71 Norduz ewes at a private sheep farm located in Gürpınar, Van. Average lactation milk yield, daily milk yield and lactation length of Norduz sheep were 125.09±0.93 kg, 695.76±5.06 g and 179.17±0.80 days, respectively. Effects of age (P<0.001), birth type (P<0.001) and body weights (P<0.05) were significant on lactation milk yield. Effects of age and birth type were significant on daily milk yield (P<0.001), but effect of body weight was not significant on daily milk yield (P>0.05). Effects of age (P<0.001), birth type (P<0.05), body weights (P<0.05) were significant on lactation length. Percentages of milk fat, total solids, protein, lactose and ash were 6.49±0.07, 16.29±0.18, 6.11±0.08, 5.07±0.17 and 0.81±0.02 %, respectively. Milk fat was affected by age and body weights (P<0.001), but milk fat was not affected by birth type (P>0.05). Age of ewe, birth type and body weights did not have a significant effect on total solids, protein, lactose and ash percentages (P>0.05). While positive correlation coefficients were detected between lactation milk yield and lactose (r_p=0.40, P<0.001), negative correlation coefficients were found between lactation milk yield and milk fat (r_p=−0.45, P<0.001), lactation milk yield and total solids (r_p=−0.49, P<0.001). In conclusion, lactation milk yield and lactation length of Norduz ewes were greater than many native sheep breeds raised in Turkey. Milk yield of Norduz ewes can be improved by effective selection programme.

***Key words**: Sheep, Lactation, Milk yield, Milk components*

Norduz koyunlarının süt verim özellikleri

ÖZET

Bu çalışma Akkaraman koyun ırkının bir varyetesi olduğu bildirilen Norduz koyunlarının süt verimini ve süt kompozisyonunu araştırmak amacıyla yapılmıştır. Araştırma, Van ili Gürpınar ilçesindeki özel bir koyun çiftliğinde 71 baş Norduz koyunu üzerinde yürütülmüştür. Norduz koyunlarının laktasyon süt verimi, günlük süt verimi ve laktasyon süresi sırasıyla 125,09±0,93 kg, 695,76±5,06 g ve 179,17±0,80 gün olarak saptanmıştır. Laktasyon süt verimi üzerine yaş, doğum tipi ve beden ağırlığının etkisi farklı düzeylerde önemli olmuştur (P<0.05, P<0.001). Günlük süt verimi üzerine yaş ve doğum tipinin etkisi çok önemli (P<0.001), beden ağırlığının etkisi ise önemsiz olmuştur (P>0.05). Laktasyon süresi üzerine yaş, doğum tipi ve beden ağırlığının etkisi farklı düzeylerde önemli olmuştur (P<0.05, P<0.001). Sütte yağ, toplam kuru madde, protein, laktoz ve kül oranları sırasıyla % 6,49±0,07, 16,29±0,18, 6,11±0,08, 5,07±0,17 ve 0,81±0,02 olarak tespit edilmiştir. Süt yağı üzerine yaş ve beden ağırlığının etkisi yüksek düzeyde (P<0.001), doğum tipinin etkisi ise önemsiz olmuştur (P>0.05). Toplam kuru madde, protein, laktoz ve kül oranları üzerine yaş, doğum tipi ve beden ağırlığının etkisi önemsiz olmuştur (P>0.05). Laktasyon süt verimi ve laktoz arasında pozitif korrelasyon (r_p=0,40, P<0.001), laktasyon süt verimi ve süt yağı arasında (r_p=−0,45, P<0.001), laktasyon süt verimi ve toplam kuru madde (r_p=−0,49, P<0.001) arasında negatif korrelasyonlar bulunmuştur. Sonuç olarak, Norduz koyunlarının laktasyon süt verimi ve süresi Türkiye'de yetiştirilen birçok yerli ırka göre daha yüksek düzeyde olduğu, etkin bir seleksiyonla Norduz koyunlarında süt veriminin daha da artabileceği kanaatine varılmıştır.

***Anahtar Kelimeler:** Koyun, Laktasyon, Süt verimi, Süt bileşimi*

INTRODUCTION

The Eastern Anatolian region has low vegetation period, drought and harsh climate. Thus, these conditions enforce farmers to livestock production, such as small ruminant production (18)

The region has sheep breeds who are high survival rate, combine production genes and adapt very well to climate conditions of region (5). It has been noted that there is a wide genetic variation regarding the sheep population of Eastern Anatolia (17). Bingöl (5) and Karaca et al. (17) reported that Norduz sheep is a type within Akkaraman breed. Norduz sheep is raised in region called "Norduz" in Gürpınar, Van. Norduz sheep are generally white, but grey, grey-white, brown-white Norduz sheep can also be found. Different parts of body, specially head, chest and legs can have black spots. Norduz sheep generally have long legs, and its neck is covered with fleece. Tail consists of three parts, and middle part is longer (5).

The milk production level of small ruminants depends primarily on the lactation length. Dairy breeds have a longer lactation length. Milk yield of sheep and goat also depends on the lactation number. It reaches a maximum at the third or fourth lactation (12).

Many researchers reported that effects of age (2, 5, 16), birth type (3) were significant on lactation milk yield. In contrast, Küçük et al. (23) reported that effects of age and birth type were not significant on lactation milk yield. Yılmaz et al. (31) reported that effects of age and birth type were significant on lactation milk yield, but effect of body weight was not significant on lactation milk yield

Akçapınar et al. (2) reported that lactation milk yield for Akkaraman sheep was 113 kg. Öztürk (28)

reported that lactation milk yield and lactation length for Hamdani sheep were 142 kg and 229.9 days.

Milk composition varies between breeds and individuals within breeds. It is also affected by stage of lactation, feeding and management and season of the year (10).

Yılmaz et al. (31) reported a negative correlations between lactation milk yield and milk fat (r_p=−0.46). Simos et al. (29) reported positive correlations between total solids and milk fat (r_p=0.89), between total solids and protein (r_p=0.45) and between milk fat and protein (r_p=0.26).

The aim of this study was to investigate milk yield and milk composition of Norduz sheep reported as a type within Akkaraman breed.

MATERIALS and METHODS

Data were obtained from a private sheep flock located in Gurpınar, Van. Two-5 year-old, 71 Norduz ewes were used in this study. All ewes were identified by ear tag. Furthermore, age of ewe, body weights of ewes at the initiation of lactation and birth type were recorded.

All ewes were maintained under identical conditions at the sheep flock. During the present study, the ewes were grazed. Sheep were started milking 5 days after lambing. Lambs were separated from their dams 24 h before each milking for daily milk yield determination. The ewes were hand-milked two times daily (8:00 and 17:00 h) every 15 days during the study. Daily milk yield per ewe were recorded. Milking of ewes were continued until milk yield decreased to 50 g/day. Lactation milk yield and lactation length for each ewes were calculated according to Swedish method (19).

Milk samples were taken at the begining of lactation and once a month. A mixture of morning and evening milk samples refrigerated at 4 °C until analysis. Milk samples were analysed for fat, dry matter, protein, lactose and ash according to the methods described by Kurt et al. (21).

Data on milk yield and components was analysed using the least squares method (15). The difference between the mean values was determined by Duncan's test. Finally, an analysis of correlation among all of the variables was performed (11).

RESULTS

Average lactation milk yield, daily milk yield and lactation length are presented in Table 1. Average lactation milk yield and daily milk yield and lactation period were 125.09±0.93 kg, 695.77±5.06 g and 179.17±0.80 days, respectively. Lactation milk yield, daily milk yield and lactation period increased with increasing age and body weights of ewes. Lactation milk yield, daily milk yield and lactation length were greater for ewes who had twin lamb than those who had single lamb. Effects of age (P<0.001), birth type (P<0.001) and body weights (P<0.05) were significant on lactation milk yield. Effects of age and birth type were significant on daily milk yield (P<0.001), but not body weights (P>0.05). Effects of age (P<0.001), birth type and body weights (P<0.05) were significant on lactation length.

Table 1. Least square means, standart erros and significance probabilities for lactation milk yield, daily milk yield and lactation length.

Factors	n	Lactation milk yield (kg)		Daily milk yield (g)		Lactation length (days)	
		$\overline{X}$	± S$\overline{x}$	$\overline{X}$	± S$\overline{x}$	$\overline{X}$	± S$\overline{x}$
Expected mean	71	125.09	0.93	695.76	5.06	179.17	0.80
		***		***		***	
Age (Year)							
2	13	106.72^{d}	2.23	647.45^{c}	12.14	164.50^{c}	1.92
3	34	121.69^{c}	1.26	677.49^{bc}	6.86	179.64^{b}	1.08
4	12	129.65^{b}	2.15	698.07^{b}	11.72	185.83^{a}	1.85
5	12	142.29^{a}	2.01	760.04^{a}	10.99	186.73^{a}	1.73
		***		***		*	
Birth type							
Single	56	121.06	0.95	680.15	5.19	177.32	0.82
Twin	15	129.12	1.59	711.37	8.67	181.03	1.34
		*		-		*	
Body weight (kg)							
40-45	11	120.83^{c}	2.48	685.48	13.52	175.43^{c}	2.14
46-50	16	124.59^{bc}	1.74	699.48	9.53	177.54^{bc}	1.50
51-55	23	125.53^{ab}	1.51	692.11	8.23	180.93^{ab}	1.30
≥56	21	129.40^{a}	1.56	705.98	8.47	182.79^{a}	1.34
Regression (linear) of lactation length		0.389***					

In columns (within each factor) values with different superscripts are significant at P<0.001 and P<0.05.
-: P>0.05; *P<0.05; ***P<0.001

Percentages of fat, total solids, protein, lactose and ash in milk are presented Table 2. Percentages of milk fat, total solids, protein, lactose and ash were 6.49±0.07, 16.29±0.18, 6.11± 0.08, 5.07±0.17 and 0.81±0.02 %, respectively. Milk fat percentage increased with decreasing age and live weights of ewes. Milk fat was affected by age and body weights (P<0.001), but milk fat was not affected by birth type (P>0.05). Age of ewe, birth type and body weights did not have a significant effect on total solids, protein, lactose and ash (P>0.05).

Table 2. Least square means, standart errors and significance probabilities for fat, total solids, protein, lactose and ash in milk.

Factors	n	Fat (%)		Total solids (%)		Protein (%)		Lactose (%)		Ash (%)	
		$\overline{X}$	S $\overline{x}$	$\overline{X}$	S $\overline{x}$	$\overline{X}$	S $\overline{x}$	$\overline{X}$	S $\overline{x}$	$\overline{X}$	S $\overline{x}$
Expected mean	71	6.49 ***	0.07	16.29 -	0.18	6.11 -	0.08	5.07 -	0.17	0.81 -	0.02
Age (Year)											
2	13	6.88[a]	0.12	16.59	0.33	6.32	0.15	5.05	0.31	0.87	0.04
3	34	6.71[a]	0.09	16.23	0.24	6.13	0.11	4.75	0.22	0.79	0.03
4	12	6.21[b]	0.14	16.20	0.39	6.11	0.17	4.99	0.36	0.79	0.05
5	12	6.16[b]	0.12	16.15	0.38	5.89	0.15	5.50	0.31	0.79	0.04
Birth Type		-		-		-		-		-	
Single	56	6.53	0.07	16.48	0.18	6.13	0.08	5.17	0.16	0.84	0.02
Twin	15	6.45	0.12	16.11	0.32	6.09	0.14	4.97	0.29	0.78	004
Body weight (kg)		***		-		-		-		-	
40-45	11	6.69[a]	0.11	16.54	0.35	6.29	0.16	4.98	0.13	0.87	0.05
46-50	16	6.58[a]	0.13	16.32	0.29	6.11	0.13	4.89	0.32	0.81	0.03
51-55	23	6.45[ab]	0.09	16.20	0.24	5.83	0.11	5.05	0.22	0.81	0.03
≥56	21	6.24[b]	0.09	16.11	0.25	6.21	0.11	5.36	0.24	0.76	0.03

In columns (within each factor) values with different superscripts are significant at P<0.001.
-: P>0.05; ***P<0.001

Phenotypic correlation coefficients between lactation milk yield and milk components are presented in Table 3. Positive correlation coefficients were detected between lactation milk yield and lactose (r_p=0.40, P<0.001), milk fat and total solids (r_p=0.83, P<0.001), total solids and protein (r_p=0.35, P<0.01), total solids and ash (r_p=0.09, P>0.05), protein and milk fat (r_p=0.25, P<0.05), protein and ash (r_p=0.42, P<0.001). Negative correlation coefficients were found between lactation milk yield and milk fat (r_p=−0.45, P<0.001), lactation milk yield and total solids (r_p=−0.49, P<0.001), lactation milk yield and protein (r_p=−0.28, P<0.05), lactation milk yield and ash (r_p=−0.18, P>0.05), total solids and lactose (r_p=−0.48, P<0.001), milk fat and lactose (r_p=−0.54, P<0.001), protein and lactose (r_p=−0.34, P<0.01), lactose and ash (r_p=−0.19, P>0.05).

Table 3. Phenotypic correlation coefficients between lactation milk yield and milk components.

	Fat	Total solids	Protein	Lactose	Ash
Lactation milk yield (kg)	−0.45***	−0.49***	−0.28*	0.40***	−0.18-
Fat		0.83***	0.25*	−0.54***	0.11-
Total solids			0.35**	−0.48***	0.09-
Protein				−0.34**	0.42***
Lactose					−0.19-

-: P>0.05; *P<0.05; **P<0.01; ***P<0.001

DİSCUSSİON

In this study, lactation milk yield of Norduz ewes was found as 125.09 kg. Effects of age (P<0.001), birth type (P<0.001) and body weights (P<0.05) were significant on lactation milk yield. Lactation milk yield of Norduz ewes was greater than those reported for Morkaraman (113 kg) (2), Karacabey Merinosu (100.3 kg) (4), Chios (73.92 kg) and İmroz (89.66 kg) (8), İvesi (86.9 kg) (14), Hamdani (69.79 kg), Karagül (61.47 kg), Morkaraman (70.88 kg) (23), Akkaraman (56.56 kg), Morkaraman (96.37 kg) and İvesi sheep (109.90 kg) (27), Karakaş-Akkaraman (50.50 kg) (31); was lower than that of Hamdani (142.4 kg) (28); was similar to the result reported for Chios x İvesi (F_1) sheep (126.8 kg) (14). Effects of age and birth type were significant on lactation milk yield in this study, which are in agreement with the results reported in the literatures (2, 3, 16).

Daily milk yield was found as 695.76 g in the study. Daily milk yield of Norduz ewes was greater than those reported for Dağlıç ewes (333 g) (9), Akkaraman (350 g) (22), Karakaş-Akkaraman (341.86 g) (31); was lower than that reported for Chios ewes (1020 g) (1). Effects of age and birth type were significant on daily milk yield in this study, but not body weights. These observations are supported by Yılmaz et al. (31).

Average lactation milk yield and daily milk yield were greater in Norduz sheep compared with those of other native sheep breeds. The greater lactation milk yield and daily milk yield observed in Norduz sheep can be explained by its genetic characteristics and better adaptation to region where raised. Lactation and daily milk yields demonstrate the potential for milk production of Norduz ewes.

Lactation length was determined as 179.17 days in this study. Effects of age, birth type and body weights were significant (P<0.05, P<0.001) on lactation length. Lactation length of Norduz ewes was greater than those reported for Akkaraman sheep (146.90 days) (26), Akkaraman (134.43 days), Morkaraman (164.74 days), İvesi (169.44 days) (27), Hamdani (142.4 days) (28); was lower than the value reported for İmroz sheep (223 days)

(8); was similar to the results reported for Norduz (183.37 day) (5) and İvesi sheep (179 days) (13). Effect of age was significant on lactation length in the present study. This observation is supported by Yılmaz et al. (31).

Milk fat percentage was determined as 6.49 % in the present study. Milk fat was significantly affected by age and body weights, but milk fat was not affected by birth type. Milk fat percentage of Norduz ewes was similar to the results reported for Targhee ewes (6.5 %) (6), Chios (6.6 %) (25), Karakaş-Akkaraman (6.60 %) (31); was lower than the value reported for Hamdani ewes (7.45 %) (28).

Protein percentage was found as 6.11 % in this study. Age, birth type and body weights did not have a significant effect on protein. Protein percentage in milk of Norduz ewes was similar to the results reported for Rambouillet (6.2 %), Suffolk (6.2 %) and Targhee ewes (6.1 %) (6), Chios ewes (6.0 %) (25); was higher than those reported for Massese (4.7 %) (7) and Suffolk ewes (5.0 %) sheep (30). Milk fat, protein and total solids displayed an inverse relationship with milk yield. Effects of the physiological factors on milk quality may often be confounding. Nutrition can be regarded as one of the most important sources of variation in the yield and composition of milk.

Lactose percentage was determined as 5.07 % in the present study. Age, birth type and body weights did not have a significant effect on lactose. Lactose percentage (5.07 %) observed in this study is in agreement with the results reported for Rambouillet (4.9 %) (6) and Corriedale ewes (5.2 %) (20).

In the present study, phenotypic correlation coefficients between lactation milk yield and fat, lactation milk yield and protein, total solids and protein, fat and protein, total solids and fat were –0.45, –0.28, 0.35, 0.25 and 0.83, respectively. Mariá and Gabiña (24) reported phenotypic correlation coefficients of –0.27 between milk yield and milk fat and –0.24 between milk yield and protein. The lactose content was inversely proportional to milk fat, protein and ash. Simos et al. (29) reported phenotypic correlation coefficients between total solids and protein (0.45), between milk fat and protein (0.26) and between total solids and milk fat (0.89). In a previous study, in Karakaş-Akkaraman, Yılmaz et al. (31) reported phenotypic correlation coefficient of –0.46 between milk yield and milk fat.

In conclusion, average lactation milk yield, daily milk yield and lactation length of Norduz ewes were 125.09 kg, 695.76 g and 179.17 days, respectively. Lactation milk yield and lactation length of Norduz ewes were found greater than those of many native sheep breeds raised in Turkey. Milk yield of Norduz ewes can be improved by effective selection programme.

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REFERENCES

1. Akçan A, Özbeyaz C, Aydoğan M, Çetin O (1988): Antalya Boztepe'de yetiştirilen Chios sürüsünde bazı verim özelliklerinin incelenmesi. Doğa Türk Vet. Hay. Derg., 12: 99-112.

2. Akçapınar H, Kadak R, Odabaşıoğlu F (1982): Morkaraman ve Kangal-Akkaraman koyunlarının döl verimi ve süt verimi üzerinde karşılaştırmalı araştırmalar. Ankara Üniv. Vet. Fak. Derg., 29: 379-391.

3. Akmaz A, Kadak R, Tekin ME, Deniz S, Nazlı M (1992): Konya Merinoslarında farklı dönemlerde sütten kesmenin kuzularda büyüme ile koyunlarda süt ve yapağı verimine etkisi. Hay. Araş. Derg., 2: 1-7.

4. Başpınar H, Oğan M, Batmaz ES, Petek M, Karamustafaoğlu M (1996): Karacabey Merinosu koyunlarının yarı-entansif koşullarda başlıca verim özellikleri üzerine bir araştırma. I. döl verimi özellikleri, süt verimi ve sıfat öncesi canlı ağırlığı. Hay. Araş. Derg., 6: 40-44.

5. Bingöl, M (1998): Norduz koyunlarının döl ve süt verimi ile büyüme-gelişme ve dış yapı özellikleri. (Doktora Tezi)., YYÜ. Fen. Bil. Enst, Van.

6. Boylan WJ, Fecht JW, Sakul H (1988): Deary sheep performance and potential. ın: proceedings of the sixtieth annual "sheep and lamb feeders day", 54-63, University of Minnesota, West Central Experiment Station, Morris, MN, USA.

7. Casoli C, Duranti E, Morbidini L, Panella F, Vizioli V (1989): Quantitative and compositional variations of Massese sheep milk by parity and stage of lactation. Small Rumin. Res., 2: 47-62.

8. Çörekci SG, Evrim M (2000): Sakız ve İmroz koyunlarının yarı-entansif koşullardaki verim performansları konusunda karşılastırmalı araştırmalar. II. süt verimi, yapağı verimi ve yapağı özellikleri. Turk. J. Vet. Anim. Sci., 24: 545-552.

9. Demir, H (1989): Dağlıç ve Ramlıç koyunlarının önemli verim özellikleri yönünden karşılaştırılmaları II. döl verimi, süt verimi ve yapağı özellikleri. İstanbul Üniv. Vet. Fak. Derg., 15: 39-52.

10. Devendra, C (1991): Breed Differences in Productivity in Goats. K Maıjala (Editor), Genetic Resources of Pig, World Animal Science B 8, 431-440, Elsevier, Amsterdam.

11. Düzgünes O, Kesici T, Gürbüz F (1993): İstatistik metotları I (II. Baskı). Ankara Üniv. Ziraat Fakültesi Yayınları No: 1291, Ankara

12. Flamant JC, Morand-Fehr P (1982): Milk production in sheep and goats. IE Coop (Editor), Sheep and Goat Production, World Animal Science C 1, 273-295, Elsevier, Amsterdam.

13. Güney O, Özcan L, Gürsoy O (1982): İvesi koyunlarının Çukurova Bölgesinde adaptasyonu üzerinde araştırmalar. I. döl ve süt verimi ile ilgili özellikler. Çukurova Üniv. Ziraat Fak. Yıllığı., 13: 3-14.

14. Güney O, Özcan L, Pekel E, Biçer O, Torun O (1990): Çağdaş düzeydeki Sakız x İvesi (F_1) ve saf

İvesi koyunların çukurova koşullarındaki performansları. Çukurova Üniv. Ziraat Fak. Derg., 5: 91-100.

15. Harvey WR (1987): User's guide for LSMLMWPC-I version mixed model least squares and maximum likelihood computer program. Ohio State University, Columbus, Mimeo.

16. Ibanez M, Thos J, Urguia JJ (1991): Milk yield during the milking period in Somosierra Blond Ewes. Anim. Breed. Abstr., 60: 21-40.

17. Karaca O, Aşkın Y, Cemal İ, Çivi A (1996): Doğu Anadolu göreneksel koyun yetiştirme sistemlerinin çağdaş ıslah programları bakımından potansiyelleri. Hayvancılık' 96 Ulusal Kongresi (18-20 Eylül 1996). İzmir Ticaret Odası ve Ege Üniv. Ziraat Fak. Zootekni Bölümü., 1: 160-167.

18. Karaca O, Odabaşıoğlu F, Altın T, Söğüt B, Kaygısız A (1990): Doğu Anadolu'da tarımın verimlilik sorunları sempozyomu (9-10 Ekim 1990). Milli Prodüktivite Merkezi Yayınları., 431: 23-105.

19. Kaymakçı M, Sönmez R (1996): İleri koyun yetiştiriciliği. I. Baskı, Ege Üniv. Basım Evi, İzmir.

20. Kremer R, Roses L, Rista L, Barbato G, Perdigon F, Herrera V (1996): Machine milk yield and composition of non-dairy Corriedale sheep in Uruguay. Small Rumin. Res., 12: 61-67.

21. Kurt A, Çakmakcı S, Çağlar A. (1999): Süt ve mamülleri muayene ve analiz metodları rehberi. Atatürk Ünıv. Yay. No: 252/d, Erzurum.

22. Küçük M, Akçapınar H (1999): Akkaraman, Alman Siyah Başlı Etçi x Akkaraman melezi F_1 koyunların süt verim özellikleri. Lalahan Hay. Araşt. Enst. Derg., 39: 33-42.

23. Küçük M, Özturk Y, Bayram D (2000): Yarı-entansif şartlarda Hamdani, Karagül ve Morkaraman koyunlarının süt verim özelliklerinin karşılaştırılması. YYÜ. Vet. Fak. Derg., 11: 44-48.

24. Mariá G, Gabiña D (1993): Non-genetic effects on milk production of Latxa Ewes. Small Rumin. Res., 12: 61-67.

25. Mavrogenis AP, Louca A (1980): Effect of different husbandry systems on milk production of purebred and crossbred sheep. Anim. Prod., 31: 171-176.

26. Odabaşıoğlu F (1985): Morkaraman, Akkaraman ve İvesi koyunlarının süt verim özelliklerinin karşılaştırılması. Elazığ Bölgesi Vet. Hek. Odası Derg., 1:16-27.

27. Özbey O, Akcan A (2000): Akkaraman, Morkaraman ve İvesi koyunlarının yarı-entansif şartlardaki verim performansı I. döl ve süt verim özellikleri. Vet. Bil. Derg., 16: 109-120.

28. Öztürk Y (1998): Van ve yöresinde Hamdani koyunlarının verimleri ve morfolojik özelliklerinin araştırılması. (Doktora Tezi). YYÜ. Sağ. Bil. Enst. Van.

29. Simos EN, Nikolaou EM, Zoiopoulos PE (1996): Yield, composition and certain physicochemical characteristics of milk of the Epirus Mountain sheep breed. Small Rumin. Res., 20: 67-74.

30. Torres-Hernandez, G., Hohenboken, W (1979): Genetic and environmental effects on milk production, milk composition and mastitis incidence in crossbred ewes, milk composition and mastitis incidence in crossbred ewes. J. Anim. Sci., 49: 410-417.

31. Yılmaz O, Denk H, Arslan M (2003): Ekstansif şartlarda Karakaş-Akkaraman koyunlarının süt verim özellikleri. Vet. Bil. Derg., 19: 67-72.