

## Factors Affecting Lactation Milk Yield and Some Lactation Characteristics of Zom Sheep in Farmer Conditions

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**ABSTRACT:** This is the first scientific study for investigating and describing relationships among some lactation characteristics and environmental factors influencing lactation milk yield of Zom sheep in Turkey. The research was carried out in Çınar County in the district of Karacadağ surrounded by Diyarbakır, Şanlıurfa and Mardin provinces. A total of 309 completed lactations belonging to 303 Zom ewes in three flocks for the years 2010 and 2011 were included in the analyses. Overall means ( $\pm$ SE) of lactation milk yield (LMY), lactation length (LL) and average daily milk yield (ADMY) were 171 $\pm$ 1.8 days, 130 $\pm$ 2.2 kg and 770 $\pm$ 22.7 g, respectively. LL was significantly affected by year, flock and lambing season ( $P<0.05$ ) while LMY and ADMY were significantly affected by flock, lambing season and parity ( $P<0.05$ ).

It was concluded that the matings should be arranged so that the lambings occur in month(s) closer to spring season in order to increase LMY by means of having ewes taken benefits of fresh pasture. Milk yield records in the first three months of lactation can be used to predict LMY and be used as an early selection criteria for increasing LMY.

**Keywords:** Zom sheep, Lactation milk yield, Environmental factors, Early selection

## Yetiştirici Elinde Bulunan Zom Koyunlarının Bazı Laktasyon Özellikleri ve Laktasyon Süt Verimini Etkileyen Faktörler

**ÖZET:** Bu araştırma, Zom koyunlarının laktasyon süt verimini, laktasyon süt verimine etki eden faktörleri ve bazı laktasyon özellikleri arasındaki ilişkileri araştıran ve tanımlayan ilk bilimsel çalışmadır. Araştırma, Diyarbakır, Şanlıurfa ve Mardin şehirlerinin çevrelediği Karacadağ bölgesinde bulunan Çınar ilçesinde yürütülmüştür. Üç farklı sürüde bulunan ve 2010 ve 2011 üretim yıllarında toplam 303 baş koyuna ait 309 tamamlanmış laktasyon kaydı analizlerde kullanılmıştır. Ortalama ( $\pm$ SH) laktasyon süresi (LS), laktasyon süt verimi (LSV) ve günlük ortalama süt verimi (GOSV) sırasıyla 171 $\pm$ 1.8 gün, 130 $\pm$ 2.2 kg and 770 $\pm$ 22.7 g olarak tespit edilmiştir. Etkileri incelenen faktörlerden yıl, sürü ve kuzulama mevsimi LU üzerinde ( $P<0.05$ ), sürü, kuzulama sezonu ve laktasyon sırası ise LSV ve GOSV üzerinde önemli etkiye sahip olmuştur ( $P<0.05$ ).

Araştırma sonucuna göre, koyunların taze meradan daha iyi yararlanarak daha yüksek LSV'ye sahip olmaları için, koç katım zamanının kuzulamanın bahar mevsimine yakın aylarda gerçekleşebilecek şekilde ayarlanması gerekmektedir. Kuzulamadan sonraki ilk üç ayda üretilen süt miktarının, toplam laktasyon süt veriminin tahmininde ve dolayısıyla laktasyon süt veriminin erken seleksiyonunda kullanılabileceği sonucuna varılmıştır.

**Anahtar kelimeler:** Zom koyunu, Laktasyon süt verimi, Çevre faktörleri, Erken seleksiyon

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## INTRODUCTION

Although Türkiye is one of the most important countries with various sheep breeds in terms of production type as well as genetic basis most likely resulted from various environmental factors in Anatolia and preferences of sheep breeders (Ertuğrul et al., 2011), selection and crossbreeding carried on sheep have been resulted in insufficient improvement of production of economically important traits. This insufficiency has been related to unsuccessful crossbreeding studies, lack of national and consistent genetic improvement policy and lack of technical and economic organization of sheep breeders (Sönmez et al., 2009). Nevertheless, General Directorates of Agricultural Research and Policy (GDARP) on behalf of the Ministry of Food, Agriculture and Livestock has been financially supporting and organizing genetic improvement and conservation projects for number of sheep breeds in Research Institutes and farmers conditions in the nation (Ertuğrul et al., 2011).

GDARP has also been supporting some projects for the purpose of identifying and describing some local types of sheep in terms of morphological, genetical and production types. Zom sheep, raised in Karacadağ district surrounded by Diyarbakır, Şanlıurfa and Mardin province, is first identified in one of such projects (Koncagül et al., 2012b), and a genetic improvement program for some traits such as milk yield, survival rate, growth rate, ext. has been started and continuing since 2010 - 2011 production season in Zom sheep's original rearing conditions.

Based on the farmers statements and preliminary observations, main sources of income of Zom sheep breeders are coming from milk and lamb sales. By considering the dairy sheep industry is still in the stage of development in Turkey, especially in the South East Anatolian Project (GAP) region where there is still a strong tradition for dairy sheep farming, Zom sheep is needed to be examined for milk production potential for increasing breeders' income as well as for the future growth and benefits of dairy industry. Identification of variation in milk production characteristics and the effects of various environmental factors will be useful in order to decide selection criteria and degree of emphases to be put on the traits to be improved.

Therefore, the purposes of the present study are to investigate lactation milk yield characteristics, to search the effect of environmental factors on them and

to seek an early selection criteria for total lactation milk yield in Zom sheep.

## MATERIALS AND METHODS

This study was conducted on three randomly chosen Zom sheep farms in Çınar County in the district of Karacadağ surrounded by Diyarbakır, Şanlıurfa and Mardin provinces for two years, from 2010 to 2011. A total of 309 lactation of 303 head of Zom ewes were involved in this study. As a general description of flock management in this province, briefly, the matings are started in July and lasted at the end of August and the number of ewes per ram is about 25. Additional feed suplemets before or during the mating period are not given to the ewes while the rams are provided some additional supplement of feed starting from 10 days before the matings. During the time this research was carried out, the ewes also received some additional feed about 30 days before lambing. In general, ewes and their lamb(s) were kept together about 30 days after lambing, then the ewes and lambs are seperated and gathered together for 1 to 2 hours in each morning and evening for suckling for about 2 months. The lambs are weaned around 90 days after lambing.

The milk yield was measured based on one day morning and the following day evening milking system. During the suckling period, the lambs were seperated from their dams at evening before the morning test and the following day lambs were seperated from their dams in the morning before the evening test. This procedure was routinely repeated until lambs were weaned at about 90 days of age. After weaning, the ewes were routinely milked and recorded in the morning and the following day at evening. The amount of milk recorded in the morning and evening tests were added together to obtain that test day milk yield. The ewes were test-milked starting within 10 days after the first lambing seen in the flocks and repeated every 30 days until the end of the lactations (about 6 months).

Cumulative lactation milk yield (LMY) of each ewe was calculated by Fleischmann metod (Barillet et al., 1992). General description of Fleischmann metod is:

$$LMY = MY_1 \times D_1 + \sum_{i=2}^n \frac{MY_i + MY_{i-1}}{2} \times D_i + MY_n \times 15$$

where, LMY is the cumulative lactation milk yield;  $D_1$ , the days from lambing to first milk test-day;  $D_i$  is the days from the  $i^{\text{th}}$  test day to  $(i+1)^{\text{th}}$  test day,  $MY_i$  is the total test day milk yield at the  $i^{\text{th}}$  test day, and the 15 is the assumed number of days past from last test day to the end of the lactation for a ewe. In this study, average daily milk yield was also calculated for three different senerios: S1, when the first test-day milk yield was taken within 10 days after lambing; S2, when the first test-day milk yield was taken within 10 to 20 days after lambing; or S3, when the first test-day milk yield was taken within 20 to 30 days after lambing. By doing this, it was aimed to do two things: 1) to investigate the correlations among test day milk yields, total lactation milk yield, lactation length and average daily milk yield during the lactation, and 2) to see if the lactation curve of Zom sheep is affected by the number of days from lambing the first test-day milking.

The ewes with less than lactation length of 90 days and those without first test-day within 30 days after lambing were exculuded from the data set. Environmental factors included in the model were lambing year and season, flock, type of lambing and parity. The effect of the environmental factors on the lactation length (LL), lactation milk yield (LMY) and average daily milk yield (ADMY) were investigated. Lactation length as a covariate was included in the analysis of LMY. The data were analyzed using SAS (2000) statistical package program with Proc Glim/Lsmeans statement in order to obtain least square means and standart errors of subgroups and to investigate the significance of differences among the means of subgroups. Tukey-Kramer multiple test option was used for adjustment of the significance level. Proc Corr statement was used to obtain the phenotypic correlations among the test day milk yields ( $MY_i$ ), LL, LMY and ADMY.

## RESULTS

The least square means and standart errors along with some other descriptive statistics of LL, LMY and ADMY are presented in Table 1. This table shows that the overall means ( $\pm$ SE) of LL, LMY and ADMY were  $171 \pm 1.8$  days,  $130 \pm 2.2$  kg and  $770 \pm 22.7$  g, respectively. Effect of year was significant on LL ( $P < 0.05$ ). LL was longer in the year 2011 comparing to the year

2010 due possible to managerial improvement that special care was given to mating season, thus at the end most of the ewes were lambed before January resulted in having longer lactation. The effects of flock and lambing season were significant on LL, LMY and ADMY ( $P < 0.05$ ). These results indicates that feeding and managerial conditions were different across flocks and it caused differentiation in lactation characteristics. Average lactation length was significantly longer while ADMY was significantly lower for ewes lambed earlier than those for ewes lambed late. However, this resulted in low LMY for ewes lambed earlier. This can be explained by that the ewes lambed earlier take benefits of fresh pasture less than the ewes lambed late in the lambing season.

Although LL, LMY and ADMY were different for type of lambing, the differences were not significant. The effect of parity was significant on LMY and ADMY ( $P < 0.05$ ) but was nonsignificant on LL. Ewes in first parity produced less milk yields than ewes in later lactations. There was no significant differences among the parities after the first parity.

Phenotypic correlation coefficients among test-day milk yields ( $MY_i$ ), LL, LMY and ADMY are presented in Table 2. The critical appraisal of Table 2 revealed that correlation coefficients were highly significant ( $P < 0.01$ ) between majority of the test-day milk yield ( $MY_i$ ) and LMY regardless of when the first test-day milk yield record ( $MY_1$ ) was started to be taken after lambing, except for  $MY_7$  for the first senerio (S1). The results are suggesting a strong dependence of LMY on single test-day  $MY_i$  records. Among the single test day  $MY_i$ , the highest correlation was 0.80 for  $MY_1$  of S3 ( $P < 0.01$ ). However, considering the all  $MY_i$ s within a single senerio, the correlation coefficients of  $MY_i$ s with LMY in S1 are higher than those obtained in S2 and S3, indicating that could be used for early selection criteria when ewes are subjected to selection for high LMY. The lactation shapes for S1, S2 and S3 are presented in Figure 1 showing that lactation trajectories differentiates from typical lactation curve in the case of S2 and S3.

**Table 1.** Least square means and standart errors of lactation lenght (LL), lactation milk yield (LMY) and average daily milk yield (ADMY) of Zom sheep in far

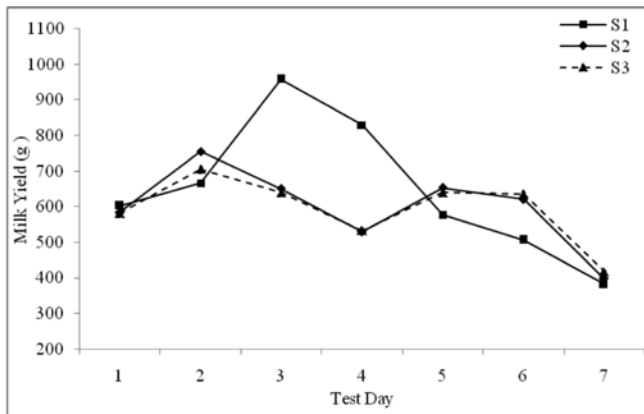
Factor / Levels	N	Lactation					Lactation					Average Daily		
		$\bar{X} \pm S_{\bar{X}}$	Min	Max	CV%	$\bar{X} \pm S_{\bar{X}}$	Min	Max	CV%	$\bar{X} \pm S_{\bar{X}}$	Min	Max	CV%	
Year	2010	126	*141±2.9 <sup>a</sup>	91	192	23	136±6.6	31	242	37	805±34.2	211	1760	41
	2011	183	197±3.2 <sup>b</sup>	149	227	8	125±6.0	58	264	30	741±37.1	314	1234	27
Flock	1	131	186±2.3 <sup>a</sup>	111	227	16	118±4.2 <sup>a</sup>	34	242	31	670±26.8 <sup>a</sup>	211	1486	33
	2	85	163±2.6 <sup>b</sup>	91	226	28	144±4.8 <sup>b</sup>	58	264	31	880±29.8 <sup>b</sup>	314	1760	41
	3	93	157±2.5 <sup>b</sup>	91	227	29	129±5.0 <sup>a</sup>	31	252	35	770±29.4 <sup>c</sup>	296	1751	41
Sezon	1	202	180±2.8 <sup>a</sup>	105	227	12	115±5.0 <sup>a</sup>	31	264	32	648±32.8 <sup>a</sup>	211	1467	30
	2	107	159±3.4 <sup>b</sup>	91	187	23	146±6.4 <sup>b</sup>	39	242	34	898±39.5 <sup>b</sup>	297	1760	38
Lambing	Single	263	167±1.5	91	227	24	133±2.9	31	264	33	884±25.2	211	1760	40
	Multiple	46	171±3.1	95	227	20	128±5.6	50	218	32	687±36.8	353	1730	38
Parity	1	61	172±2.8	91	227	23	111±5.1 <sup>a</sup>	31	196	34	664±33.2 <sup>a</sup>	211	1751	51
	2	99	173±2.5	91	226	24	133±4.5 <sup>b</sup>	50	264	31	796±28.8 <sup>b</sup>	343	1760	41
	3	78	169±2.7	91	227	21	133±4.9 <sup>b</sup>	39	220	30	786±31.1 <sup>b</sup>	297	1492	32
	4	47	171±3.2	91	227	24	137±5.9 <sup>b</sup>	47	242	33	806±37.8 <sup>b</sup>	330	1486	34
	5≤	24	161±4.3	91	226	32	137±7.8 <sup>b</sup>	64	252	39	813±49.8 <sup>ab</sup>	333	1577	37
<b>Overall</b>		309	171±1.8	91	227	24	130±2.2	31	264	33	770±22.7	211	1760	40

N: number of ewes, CV%: coefficient of variation, Sezon: 1 (November-December), 2 (January-February)

\*Different superscripts within traits and factor is different (P<0.05)

**Table 2.** Phenotypic correlations among the test day milk records (MY<sub>i</sub>), lactation length (LL), total lactation milk yield (LMY) and average daily milk yield (ADMY) in Zom sheep for three different senerios

Traits	First test-day within i <sup>th</sup> to j <sup>th</sup> day after lambing								
	S1: 0 <sup>th</sup> to 10 <sup>th</sup> day			S2: 11 <sup>th</sup> to 20 <sup>th</sup> day			S3: 21 <sup>th</sup> to 30 <sup>th</sup> day		
	LL	LMY	ADMY	LL	LMY	ADMY	LL	LMY	ADMY
MY1	-0.14 <sup>ns</sup>	0.76 <sup>**</sup>	0.74 <sup>**</sup>	0.07 <sup>ns</sup>	0.73 <sup>**</sup>	0.50 <sup>**</sup>	0.08 <sup>ns</sup>	0.80 <sup>**</sup>	0.68 <sup>**</sup>
MY2	-0.23 <sup>ns</sup>	0.75 <sup>**</sup>	0.80 <sup>**</sup>	0.56 <sup>**</sup>	0.48 <sup>**</sup>	0.90 <sup>**</sup>	-0.33 <sup>**</sup>	0.58 <sup>**</sup>	0.86 <sup>**</sup>
MY3	-0.43 <sup>**</sup>	0.74 <sup>**</sup>	0.91 <sup>**</sup>	-0.65 <sup>**</sup>	0.37 <sup>**</sup>	0.89 <sup>**</sup>	-0.52 <sup>**</sup>	0.43 <sup>**</sup>	0.86 <sup>**</sup>
MY4	-0.39 <sup>**</sup>	0.73 <sup>**</sup>	0.86 <sup>**</sup>	0.29 <sup>**</sup>	0.64 <sup>**</sup>	0.74 <sup>**</sup>	-0.35 <sup>**</sup>	0.52 <sup>**</sup>	0.79 <sup>**</sup>
MY5	0.37 <sup>*</sup>	0.70 <sup>**</sup>	0.55 <sup>**</sup>	0.47 <sup>**</sup>	0.64 <sup>**</sup>	0.44 <sup>**</sup>	0.54 <sup>**</sup>	0.75 <sup>**</sup>	0.58 <sup>**</sup>
MY6	0.36 <sup>ns</sup>	0.68 <sup>**</sup>	0.58 <sup>**</sup>	0.48 <sup>**</sup>	0.69 <sup>**</sup>	0.62 <sup>**</sup>	0.57 <sup>**</sup>	0.66 <sup>**</sup>	0.59 <sup>**</sup>
MY7	-0.36 <sup>ns</sup>	0.15 <sup>ns</sup>	0.15 <sup>ns</sup>	0.01 <sup>ns</sup>	0.47 <sup>**</sup>	0.48 <sup>**</sup>	-0.02 <sup>ns</sup>	0.37 <sup>**</sup>	0.37 <sup>**</sup>
LL		0.10 <sup>ns</sup>	-0.42 <sup>**</sup>		0.28 <sup>**</sup>	-0.59 <sup>**</sup>		0.38 <sup>**</sup>	-0.42 <sup>**</sup>
LMY			0.84 <sup>**</sup>			0.56 <sup>**</sup>			0.65 <sup>**</sup>



**Figure 1.** Lactation curves of Zom sheep for three different scenarios (S1: The first test-day is within 0 to 10 days after lambing, S2: The first test-day is within 11 to 20 days after lambing, S3: The first test-day is within 21 to 30 days after lambing).

S1: The first test-day is within 0 to 10 days after lambing, S2: The first test-day is within 11 to 20 days after lambing, S3: The first test-day is within 21 to 30 days after lambing, <sup>ns</sup> not significantly different from zero, \*significantly different from zero ( $P<0.05$ ), \*\*significantly different from zero ( $P<0.01$ )

## DISCUSSION

**Lactation Length (LL):** In the data edition step, the ewes with LL less than 90 days were not included in the analyses considering the reason that some non-genetic factors could be causing cut off the lactation before the ewes weaned their lambs. In this study, the overall mean of LL of Zom sheep was found as 171 days varied from 91 to 227 days. The effects of year, flock and lambing season were significant on LL ( $P<0.05$ ). LL in the year 2011 was longer than in 2010 possibly resulted from managerial improvement in the later year in particularly great care was given to mating period. Other than that, the flock owners, especially the owners of the first flock, paid good attention to the advices for the managerial improvement given from the project personels of the Institute and the University. As could be expected in some extent that the ewes lambed in the first two months of the lambing had longer LL than those lambed in later months.

In terms of LL, Zom sheep is similar to Norduz (Koncagul et al., 2012a), Akkaraman (Altın, 2001), Awassi, Imroz, Chios (Kaymakçı et al., 2005) and Latxa sheep (Ruiz et al., 2000) while in some researches reported shorter LL for AkkaramanxHamdani (Altın,

2001), AkkaramanxKıvırcık and AkkaramanxChios crossbred sheep (Ünal et al., 2007), Tuj and Morkaraman sheep (Kırmızıbayrak et al., 2005; Kaymakçı and Taşkın, 2001; Kaymakçı et al., 2005), Creole (Peralta-Lailsona et al., 2005) and Awassi sheep (Reidal et al., 2010), Akkaraman, Dağlıç, Kıvırcık, Karayaka (Kaymakçı and Taşkın, 2001; Kaymakçı et al., 2005). On the other hand, much longer LL was reported for Awassi sheep (Pollott and Gootwine, 2000; Gootwine et al., 2001; Pollott and Gootwine, 2001). The results and the reports in the literature show that LL was not only depends on the breed of sheep but depends also on the the environmental and/or managerial conditions in which a sheep type/breed raised.

**Lactation Milk Yield (LMY):** LL was included in the model as covariate when analysing LMY, thus the means of LMY given in Table 1 are adjusted LMY values for LL. Among the effects considered in the present study, year and type of lambing had no significant effect on LMY (Table 1). However, the effects of flock, lambing season and parity significantly affected LMY ( $P<0.05$ ). The differences in the flock means were attributable to different management factors. There were significant effects of season of lambing (season1=November-December, season2=January-February) on LMY. The higher yields were produced by the ewes lambing in season2 contrarily to the obvious expectation that ewes lambing earlier have longer lactation and higher yields. However, the results in this research indicates that the ewes lambing closer to spring have benefits of grazing on fresh pasture and produces more milk yield even though they have shorter lactation length comparing to the ewes lambing early in lambing season. Parity had significant effect on LMY, but this significance was created mainly by the ewes in the first parity. There was no significant differences among the other parities. The ewes already in the second or later parities had high yields.

Significant effect of parity, type of lambing and lambing season on LMY were reported in previous studies for Latxa (Ruiz et al., 2000), Awassi sheep (Pollott and Gootwine, 2001; Gootwine et al., 2001; Reidal et al., 2010). However, the researchers reported that the ewes lambed earlier and the ewes with multiple lambs produced more milk yields contradicting to our results in Zom sheep. On the other hand, similar founding to results in this research also reported for Norduz sheep (Koncagul et al., 2012a) that the ewes lambed closer to

spring season produced more milk yields but type of lambing had no significant effect on LMY.

The overall mean of LMY in Zom sheep was similar to Awassi and Chios (Kaymakçı and Taşkın, 2001; Kaymakçı et al., 2005) and Norduz sheep (Koncagül et al., 2012a) while higher LMY was reported for Awassi in some other studies (Pollott and Gootwine, 2000; Pollott and Gootwine, 2001; Gootwine et al., 2001; Reidal et al., 2010). On the other hand, Zom sheep produced more LMY than the other breeds/types of sheep in Turkey, for example, Akkaraman (Kaymakçı and Taşkın, 2001; Altın, 2001; Kaymakçı et al., 2005; Keskin and Dağ, 2006; Ünal et al., 2007), AkkaramanXHamdani (Altın, 2001), AkkaramanXKıvırcık and AkkaramanXChios (Ünal et al., 2007), Morkaraman (Kaymakçı and Taşkın, 2001; Kaymakçı et al., 2005; Kırmızıbayrak et al., 2005), Awassi (Dağ et al., 2005), Tuj (Kaymakçı and Taşkın, 2001; Kaymakçı et al., 2005; Kırmızıbayrak et al., 2005), Dağlıç, Kıvırcık, Karayaka, İmroz (Kaymakçı and Taşkın, 2001; Kaymakçı et al., 2005).

**Correlations Among Some Lactation Characteristics:** The phenotypic correlation among the  $MY_i$ , LL, LMY and ADMY are given in Table 2 and lactation curves are given in Figure 1 for three different senerios (S1, S2 and S3). The correlations among  $MY_1$  to  $MY_4$  with LMY and ADMY were significantly different from 0 ( $P<0.01$ ). The values are high and significant for all senerios, however, for the S1 on average, they are higher than those in S2 and S3. Based on these findings,  $MY_i$ s in the first three months of a lactation could be used as an early selection criteria for increasing LMY, constraining the  $MY_1$  measured within 10 days after lambing and continued measuring  $MY_i$ s every 30 days until weaning (S1) which seems better than S2 and S3 in this study. Similar results and suggestions were mentioned in previous researches on some milk type sheep (Macciotta et al., 1990; Pollott and Gootwine, 2001; Serrano et al., 2001; Sanna and Casu, 2002; Reidal et al., 2010).

Higher phenotypic correlation (0.57) between LL and LMY in Awassi sheep was reported previously (Pollott and Gootwine, 2001) indicating the ewes with longer LL have higher LMY. However, in the present study it was found that high LMY corresponded more to lambing months than LL in agreement with the findings in Norduz sheep (Koncagül et al., 2012a). Based on that, it could be stated that mating times can

be arranged so that the lambings could occur on months closer to the time of available fresh pasture aspecially in pasture based sheep production systems.

## CONCLUSION

In conclusion, Zom sheep is similar to Chios and Awassi sheep breeds for LL and LMY and can be considered as a fat-tailed dual purpose local sheep (milk and meat) like Norduz sheep in Turkey. There is a high variation in terms of LL, LMY and ADMY indicating planned and continuous selection program could improve LMY. For better and detailed description, more research should be conducted particularly to reveal genetic similarities/differences of Zom sheep with Awassi, Karakaş, Akkaraman and the other sheep breeds/types in Turkey.

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