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Main productive performance of Awassi sheep in the Central Anatolian Region of Turkey

Hakan ÜSTÜNER*, Mehmet Mustafa OĞAN
Department of Animal Science, Faculty of Veterinary Medicine, Uludağ University, Görükle, Bursa, Turkey

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Abstract: This study aimed to determine milk yield, fertility, lamb growth, survival rate, and the effect of environmental factors on these parameters in the Awassi sheep of the Central Anatolian Region. The fertility parameters were determined to be as follows: heat rate, pregnancy rate, parturition rate, single-born rate, twinning rate, abortion rate, lamb rate, and number of lambs per parturition, based on the number of ewes assigned for mating, were 100%, 93.8%, 90.5%, 79.7%, 20.3%, 1.4%, 108.8%, and 1.20%, respectively. The survival rates of lambs at 60 and 120 days of age were 88.3% and 84.5%, respectively. The average lactation milk yield and lactation period of the Awassi ewes were 196.5 ± 5.60 kg and 184.3 ± 2.11 days, respectively. The general death and slaughter rate of the stock was 8.2% throughout the research period. The lactation milk yield was affected by the production year ($P < 0.01$) and the age of the ewe ($P < 0.01$), but the lactation length was not affected by the same environmental factors ($P > 0.05$). The results of this study have shown that the Awassi sheep raised in the Central Anatolian Region had similar lactation milk yield, fertility parameters, and survival rates as the Awassi sheep's original race. In addition, since there were no epidemic health problems observed during the 2-year research period, Awassi sheep were shown to be adapted to being raised in this region.

Key words: Awassi, Central Anatolian Region, lactation yield, fertility parameters, environment

1. Introduction

Small ruminants in Turkey have had particular importance in animal breeding from the past to the present day. Sheep are thrifty animals (1), and their breeding requires a lower investment cost than other types of animals, which is why sheep are the preferred livestock animal in Turkey. The indigenous sheep breeds account for 97% of the sheep in Turkey. The remaining 3% are Merinos and Merino crosses. According to recent statistics published by TÜİK (2010), there are approximately 23 million sheep in Turkey. These numbers represent 18% of Turkey's meat production and 7.8% of Turkey's milk production (2). The Awassi breed is traditionally kept for the production of milk and meat and plays a socioeconomic role that does not exceed the importance of cattle in Turkey.

The Awassi is the most popular fat-tailed sheep in the Near and Middle Eastern regions (3). The Awassi are raised in the south of Turkey, Iraq, Israel, Jordan, and Syria. Unfortunately, the Awassi has taken its place among the genotypes of indigenous genetic resources requiring a protection project due to their declining numbers. Awassi sheep are well adapted to the conditions of scarce feed availability and high environmental temperatures (4). The Awassi breed has spread from its countries of origin to other countries in all continents of the world besides Antarctica, and the Awassi is used for breeding purposes (5).

Agriculture and animal husbandry are important sources of income in Central Anatolia. Approximately one-third of the grain production in Turkey occurs in this region. No dairy sheep breed is commonly raised in this region. It is clearly of interest to estimate how the Awassi performs under this different environmental condition in regards to milk production, fertility parameters, and the survival rates of lambs.

This research presents some performance results (lactation milk yield, fertility, survival rate, and lamb growth performance) of Awassi sheep in the central region of Turkey.

2. Materials and methods

The Central Anatolian Region, specifically Eskişehir, is located at 39°N and 30°E. It has a continental climate. The winters are cold and snowy; summers are hot and without rain. The average temperature ranges between 21.5 °C and –0.8 °C (July and January, respectively). The annual precipitation is 373.6 mm. The data that we used for this study were derived from an Awassi flock that was located 55 km northeast of Eskişehir. A total of 147 ewes and 155 lambs were studied during the 2-year experimental period. The semiintensive management system of this flock was provided by the Ceylanpınar State Farm.

* Correspondence: hustuner@uludag.edu.tr

The lambs were identified by ear tags. Nothing about the care and feeding management changed during the research period; therefore, the ewes mated at the beginning of October. Reproductive management included 45-day (October through November) breeding periods during the years when the ewes were hand-mated following heat detection. The ewes and rams received supplemental feeding from 3 weeks before to 2 weeks after this breeding period (flushing). During this period, every ewe was fed with a concentrate mixture consisting of 1.0 kg beef grower feed (10.47 MJ/kg ME), 0.5 kg alfalfa hay (8.62 MJ/kg ME), 0.2 kg barley (11.96 MJ/kg ME), and 0.5 kg straw (8.13 MJ/kg ME.). In addition, the flock grazed on poor pasture. The rams were fed with a concentrate mixture consisting of 1.0 kg beef grower feed (10.47 MJ/kg ME) and 1.0 kg straw (8.13 MJ/kg ME). During the months of November through January, the feeding program changed. During this period, the ewes were fed with 0.4 kg concentrate mixture (beef grower feed, 10.47 MJ/kg ME), 0.4 kg barley (11.96 MJ/kg ME), and 0.4 kg straw (8.13 MJ/kg ME). From February through October, the ewes were fed with 1.0 kg concentrate mixture (sheep dairy milk feed, 11.51 MJ/kg ME), 2.0 kg corn silage (2.51 MJ/kg ME), and 0.25 kg straw (8.13 MJ/kg ME). All the lambs were fed the same concentrate mixture, consisting of lamb starter feed (11.72 MJ/kg) and alfalfa hay (8.62 MJ/kg ME), before weaning. The concentrate mixture was changed to lamb grower feed (10.46 MJ/kg) after weaning. All the animals had free access to clean drinking water, shade, and mineral blocks during the research period. The lambs were weaned at approximately 2 months (60 days) of age. After weaning, all female lambs were fed with 0.5 kg concentrate feed mixture (beef starter feed, 10.67 MJ/kg) and 0.7 kg straw (8.13 MJ/kg ME).

All data pertaining to milk production (lactation period) and reproductive performance (lambing seasons) were compiled for 2 years. Lambing data for both ewes and lambs were recorded at lambing. These data included the ewe age (when lambing), litter size, lamb sex, birth date, birth weight, and the identity of the lamb's father and mother. In addition to these, abortions, deaths, and slaughtered sheep of the flock were recorded. During the preweaning period, all lamb weights were recorded fortnightly. After the weaning period, the lambs' weights were recorded once per month using scales sensitive to 50 g. Lamb survival rates were also recorded at weaning. These data were used to calculate the pregnancy and lambing rates, weaning survival rate, and the number of lambs born per mated ewe. The lambing rates were calculated by dividing the number of born lambs by the number of ewes and then multiplying the result by 100. The survival rates of the lambs at 60 and 120 days of age were calculated by dividing the number of live lambs by the number of lambs born and then multiplying the result by 100. The absolute weights of the lambs at 30, 60, 90, 120, and 180 days of age were calculated by the linear interpolation of the weights obtained in consecutive weight measurements. The survival rate, growth characteristics, and the effects of the factors (sex, birth type, year, and ewe age) affecting the growth of the lambs were analyzed using the general linear model (GLM) procedure. The model below was used to calculate the growth characteristics:

$Y_{ijkl} = \mu + a_i + b_j + t_k + s_l + e_{ijkl}$, where Y_{ijkl} = production of any animal, μ = overall mean, a_i = effect of dam age, b_j = effect of year, t_k = effect of birth type, s_l = effect of sex of lamb, and e_{ijkl} = random error. With this model, it was assumed that there were no significant interactions between the factors investigated, and the sum of the effects of the subgroups of factors was assumed to be zero. The fertility parameters were analyzed using the chi-square test. The statistical analyses were performed using Minitab 14.2 (6).

Milk production was recorded fortnightly during the lamb suckling period and after weaning. During this time, the lambs were separated from the dams overnight, 12 h prior to milking. The ewes were milked with the aid of a milking machine twice daily from the day of lambing until their milk yield dropped to approximately 0.05 L/day or until they had to be dried off before mating seasons. Data were recorded for 2 lactation periods and calculated as described by Pollot and Gootwine (7). The lactation milk yield, lactation period, and the effects of the factors (age and year) affecting the milk yield were analysed using the GLM procedure. The model below was used to calculate the milk yield and lactation period characteristics:

$Y_{ij} = \mu + A_i + B_j + E_{ij}$, where Y_{ij} = production of any animal, μ = overall mean, A_i = effect of age, B_j = effect of year, and E_{ij} = random error. With this model, it was assumed that there were no significant interactions between the factors investigated, and the sum of the effects of the subgroups of factors was assumed to be zero. The statistical analyses were performed with the GLM procedure of Minitab 14.2 (6).

3. Results

The lambing data of the Awassi sheep are presented in Table 1. The differences among pregnancy rate, birth rate, lambing rate, and fecundity are not statistically significant ($P > 0.05$), but the twinning rates of first and second parity were lower than the others. The present study showed that the productive traits increased nonsignificantly ($P > 0.05$) with each advancing year of production for the pregnancy rate (93.4%), twinning rate (22.6%), lambing rate (114.5%), and fecundity (1.22%).

The survival rate data for days 60 and 120 are shown in Table 2. The survival rate of female lambs was higher than that of male lambs, and the percentages of the male

Table 1. Fertility of Awassi sheep.

	n	Pregnancy rate n %		Single birth rate n %		Twinning rate n %		Lambing rate n %		Litter size
Parity										
1	19	16	89.4*	16	100[a]	–	–[a]	16	84.2*	1.00
2	33	29	87.9*	27	93.1[a]	2	6.90[a]	31	93.9*	1.07
3	37	34	91.9*	27	79.4[b]	7	20.6[b]	41	110.8*	1.20
4	40	36	90.0*	25	69.4[b]	11	30.5[b]	47	117.5*	1.30
5	18	17	94.4*	10	58.8[b]	7	41.2[b]	24	133.3*	1.41
Production year										
1	71	61	85.9*	50	80.6*	11	17.7*	72	101.4*	1.18
2	76	71	93.4*	55	77.5*	16	22.6*	87	114.5*	1.22
Overall	147	132	89.8	105	79.5	27	20.5	159	108.2	1.20

*: Nonsignificant (P > 0.05).
[a,b]: Means within the same column with different letters differ significantly at P < 0.05.
Lambing rate: Lambs born per ewe exposed.

Table 2. Survival rate of Awassi lambs (%).

Production traits		n	Day 60 n %		Day 120 n %	
Sex	Male	70	57	81.4[b]	53	75.7[d]
	Female	85	80	94.1[a]	78	91.8[c]
Age of dam						
2		16	13	81.3*	13	81.3*
3		29	27	96.4*	25	86.2*
4		39	35	89.7*	34	87.2*
5		47	42	87.5*	40	85.1*
6		24	20	83.3*	19	79.2*
Production year						
1		72	62	86.1*	60	83.3*
2		83	75	90.4*	71	85.5*
Overall		155	137	88.3	131	84.5

*: Nonsignificant (P > 0.05).
[a,b]: Means within the same column with different letters differ significantly at P < 0.05.
[c,d]: Means within the same column with different letters differ significantly at P < 0.01.

and female lambs that reached 60 days of age were 81.4% and 94.1% (P < 0.05), respectively. The percentages for the male and female lambs that reached 120 days of age were 75.7% and 91.8% (P < 0.01), respectively. The differences among the survival rates, age of ewes, and production year were not statistically significant (P > 0.05). The general survival rates at 60 and 120 days of age were found to be 88.3% and 84.5%, respectively.

The milk production results for the 2 years are shown in Table 3. In this research, the lactation milk yield and lactation length were 196.5 ± 5.60 kg and 184.3 ± 2.11 days, respectively. The amount of milk yield for 2-year-old ewes (156.1 ± 12.72) was lower than the yield for the other ewes, and the effects of age (P < 0.05) and production year (P < 0.01) on the lactation milk yield were statistically significant. No significant differences (P > 0.05) of those parameters on the lactation period were found.

The results for the weight of lambs at birth and 30, 60, 90, 120, and 180 days of age are shown in Tables 4 and 5. The average lamb birth weight and weight at 30, 60, 90, and 120 days of age were 4.52 ± 0.07 kg, 9.94 ± 0.22 kg, 17.34 ± 0.37 kg, 23.26 ± 0.54 kg, and 29.14 ± 0.73 kg,

Table 3. Lactation milk yield (kg) and lactation period (days) of Awassi sheep.

Production traits		Lactation milk yield (kg)		Lactation period (days)
		n	$\overline{X} \pm S_{\overline{X}}$	$\overline{X} \pm S_{\overline{X}}$
Age of ewe	2	15	156.1 ± 12.72[b]	189.2 ± 5.65*
	3	24	204.0 ± 10.07[a]	185.8 ± 4.49*
	4	31	205.6 ± 8.80[a]	177.6 ± 3.90*
	5	33	208.4 ± 8.48[a]	181.0 ± 3.78*
	6	17	198.4 ± 12.81[a]	188.2 ± 5.70*
Production year	1	55	185.0 ± 6.17[y]	182.3 ± 2.75*
	2	65	204.0 ± 7.44[x]	186.4 ± 3.31*
Overall		120	196.5 ± 5.60	184.3 ± 2.11

*: Nonsignificant (P > 0.05).
[a,b]: Means within the same column with different letters differ significantly at P < 0.05.
[x,y]: Means within the same column with different letters differ significantly at P < 0.01.

Table 4. Least squares mean live body weights of Awassi lambs (kg).

Production traits		Birth weight		30-day weight		60-day weight	
		n	$\overline{X} \pm S_{\overline{X}}$	n	$\overline{X} \pm S_{\overline{X}}$	n	$\overline{X} \pm S_{\overline{X}}$
Type of birth	Single	97	5.08 ± 0.07[a]	96	11.16 ± 0.24[e]	92	18.77 ± 0.40[g]
	Twin	48	3.96 ± 0.11[b]	45	8.72 ± 0.36[f]	45	15.90 ± 0.60[h]
Age of dam	2	14	4.17 ± 0.20*	14	9.13 ± 0.62*	13	16.57 ± 1.06*
	3	28	4.55 ± 0.14*	28	9.81 ± 0.44*	27	16.47 ± 0.73*
	4	36	4.58 ± 0.12*	35	10.03 ± 0.38*	35	17.50 ± 0.63*
	5	43	4.60 ± 0.10*	42	10.41 ± 0.33*	42	18.40 ± 0.55*
	6	24	4.71 ± 0.15*	22	10.32 ± 0.50*	20	17.73 ± 0.87*
Production year	1	62	4.50 ± 0.10*	62	10.15 ± 0.33*	62	16.64 ± 0.55[p]
	2	83	4.54 ± 0.08*	79	9.73 ± 0.27*	75	18.03 ± 0.45[m]
Sex	Male	61	4.69 ± 0.10[c]	58	10.20 ± 0.31*	57	18.15 ± 0.52[k]
	Female	84	4.35 ± 0.08[d]	83	9.68 ± 0.27*	80	16.53 ± 0.45[r]
Overall		145	4.52 ± 0.07	141	9.94 ± 0.22	137	17.34 ± 0.37

*: Nonsignificant (P > 0.05).
[g,h]: Means within the same column with different letters differ significantly at P < 0.05.
[a,b]; [k,r]: Means within the same column with different letters differ significantly at P < 0.01.
[c,d]; [e,f]; [p,m]: Means within the same column with different letters differ significantly at P < 0.001.

respectively. The average weight of the female lambs at 180 days of age was 38.07 ± 0.67 kg. As shown in Tables 4 and 5, a significant difference can be observed in the weights between the birth types except for on day 180, and the single-born lambs weighed more than the twins.

4. Discussion

During the research period, the second year's milk yield (204 ± 7.44 kg) was higher than that of the first year (185.0 ± 6.17 kg) (P < 0.01). Pasture conditions and management can influence this difference. The milk yield of Awassi ewes shows extensive variation; in this research, the total milk yield findings are higher than some reported milk yields (8–11) but lower than others (12–15).

In this research, the birth weight was 4.52 ± 0.07 kg, and the 30-, 60-, 90- and 120-day live weights were 9.94 ± 0.22, 17.34 ± 0.37, 23.26 ± 0.54, and 29.14 ± 0.73 kg, respectively. Examining Table 4 shows that while the birth

Table 5. Least squares mean live body weights of Awassi lambs (kg).

Production traits		90-day weight		120-day weight		180-day weight	
		n	$\overline{X} \pm S_{\overline{X}}$	n	$\overline{X} \pm S_{\overline{X}}$	n	$\overline{X} \pm S_{\overline{X}}$
Type of birth	Single	92	25.05 ± 0.57^{a}	89	30.68 ± 0.78^{e}	52	39.22 ± 0.67*
	Twin	43	21.47 ± 0.88^{b}	42	27.62 ± 1.19^{f}	21	36.93 ± 1.11*
Age of dam	2	13	22.40 ± 1.52*	13	27.87 ± 2.05*	10	36.75 ± 1.61*
	3	27	21.69 ± 1.07*	25	27.87 ± 1.49*	11	38.65 ± 1.47*
	4	34	23.13 ± 0.91*	34	30.14 ± 1.22*	20	36.80 ± 1.06*
	5	41	23.85 ± 0.79*	40	29.20 ± 1.08*	22	40.04 ± 1.03*
	6	20	25.23 ± 1.23*	19	30.67 ± 1.70*	10	38.16 ± 1.60*
Production year	1	61	23.23 ± 0.79*	60	29.16 ± 1.08*	33	40.19 ± 0.98^{k}
	2	74	23.29 ± 0.65*	71	29.13 ± 0.90*	40	35.97 ± 0.81^{m}
Sex	Male	55	25.00 ± 0.76^{c}	53	31.41 ± 1.04^{g}	–	–
	Female	80	21.52 ± 0.64^{d}	78	26.89 ± 0.87^{h}	–	–
Overall		135	23.26 ± 0.54	131	29.14 ± 0.73	73	38.07 ± 0.67

*: Nonsignificant ($P > 0.05$).
^{e,f}; ^{k,m}: Means within the same column with different letters differ significantly at $P < 0.05$.
^{a,b}; ^{c,d}; ^{g,h}: Means within the same column with different letters differ significantly at $P < 0.001$.

type ($P < 0.01$) and sex ($P < 0.001$) affected birth weight, the parity and production year had no significant effect. The birth type was also affected by the other live weights. The effect of sex was determined to be significant on the 60-, 90- and 120-day live weights ($P < 0.01$, $P < 0.001$, $P < 0.001$, respectively).

The birth and weaning weights (60 days) found in this study were higher than the values reported by Emsen and Yaprak (16) as 3.34 and 14.63 kg, respectively, and by Kul and Akçan (17) as 4.15 and 11.53 kg, respectively. Pollot et al. (18) and Kridli et al. (19) reported the birth weight as 4.8 kg, Hassen et al. (20) as 4.05 kg in Awassi lambs, Esenbuğa and Dayıoğlu (21) as 4.17 kg in Awassi lambs, and Dikmen et al. (22) as 4.31 kg in Awassi lambs. While the birth weights obtained in almost all of the above studies for similar genotypes exhibit parallels to the results achieved in the present study, the results from this study were higher than the values reported by Özbey and Akçan (23) as 3.9 kg and by Hassen et al. (20) as 4.05 kg in Awassi lambs. In the findings of this research, the type of birth and sex affected birth weight, such that the results showing that the birth weight was higher in males compared to females and in single-born lambs compared to twins were similar to those stated by Dikmen et al. (22).

In this research, the survival rates were found to be similar to those found by Kridli et al. (19) as 83% and higher than the 81% value reported by Aksakal et al. (24), but lower than others (23,25).

The fertility of Awassi ewes ranged from 85.0% to 92.2% in Turkey, and the litter size ranged from 1.02 to 1.4 in different countries (5,12,26,27,28). The pregnancy rate during this research (93.8%) is higher than that observed for some of Turkey's pregnancy rate findings and others (12,19,26). Litter sizes in the first and second year were found to be 1.18 and 1.22, respectively. The identified values were found to be higher than the values reported by Alkass and Juma (10), Gürsoy et al. (12), Kridli et al. (19), Özsoy et al. (26), and Kassem (29), but the identified values were found to be lower than those of Gootwine et al. (28).

In many locations, the Awassi has become the breed of preference, especially for dairy because of its high performance and ability to produce under varied production environments. The Awassi sheep breed is an important genetic resource that plays a significant role in milk and lamb production in the Central Anatolian Region in addition to the region of its origin. According to the results of this study, Awassi sheep can be successfully raised under Central Anatolian conditions.

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References

1. Macit, M., Atasoy A.: The comparison of some important production traits of Awassi and Red Karaman ewes reared in the semi-intensive conditions at Atatürk University Agricultural Research and Application Farm. Turk. J. Vet. Anim. Sci., 1996; 20: 465–470.
2. TÜİK: 2010 Statistics. Turkish Statistical Institution, Ankara. 2010. www.tuik.gov.tr.
3. Al Jassim, R.A.M., Aziz, D.I., Zorah, K., Black, J.L.: Effect of concentrate feeding on milk yield and body-weight change of Awassi ewes and the growth of their lambs. J. Anim. Sci., 1999; 69: 441–446.
4. Said, S.I., Kridli, R.T., Muwalla, M.M.: Estimation of milk yield in suckled Awassi sheep under traditional feeding conditions. J. Appl. Anim. Res., 1999; 16: 163–168.
5. Galal, S., Gürsoy, O., Shaat, I.: Awassi sheep as a genetic resource and efforts for their genetic improvement – a review. Small Ruminant Res., 2008; 79: 99–108.
6. Minitab: Minitab Reference Manual, Release 14.2. Minitab Inc., State College, PA, USA. 2005.
7. Pollott, G.E., Gootwine, E.: Appropriate mathematical models for describing the complete lactation of dairy sheep. Anim. Sci., 2000; 71: 197–207.
8. Sönmez, R., Kaymakçi, M.: Koyun Yetiştiriciliği. Hasad Yayıncılık, İstanbul. 1992 (in Turkish).
9. Koluman,, D.N., Güney, O.: Performance and physiological reactions of pure Awassi and East-Friesian × Awassi crossbred ewes under sub-tropic Çukurova region. In: Proceedings of the Meeting of the Subnetwork on Animal Resources, FAO-CIHEAM Network of Cooperative Research on Sheep and Goats and Subnetwork on Animal Resources. Jointly Organized with the Station d'Amélioration Génétique des Animaux-INRA, Toulouse, France, 9–11 March, 1997.
10. Alkass, J.E., Juma, K.H.: Small ruminant breeds of Iraq. In: Iñiguez, L., Ed. Characterization of Small Ruminant Breeds in West Asia, North Africa, Vol. 1, West Asia. ICARDA, Aleppo, Syria. 2005; 63–101.
11. Bahmen, A., El-Shahdy, S.: Sheep Breeding in Kuwait. Animal Production Management, Ministry of Agriculture, Kuwait. 1985.
12. Gürsoy, O., Pekel, E., Özcan, L., Torun, O., Timon, V.: Genetic selection for milk yield in Awassi sheep. I. Reproduction, lactation. Turk. J. Vet. Anim. Sci., 1992; 16: 535–546.
13. Goot, H.: Milk yield, lactation length of single, twin born Assaf dairy ewes. Israel J. Ag. Res., 1974; 23: 155–158.
14. Rummel, T., Zárate, A.V., Gootwine, E.: The Worldwide Gene Flow of the Improved Awassi, Assaf Sheep Breeds from Israel. Grauer, Beuren, Stuttgart. 2005.
15. Gootwine, E., Bor, A., Braw-Tal, R., Zenou, A.: Reproductive performance and milk production of the improved Awassi breed as compared with its crosses with the Booroola Merino. Anim. Sci., 1995; 60: 109–115.
16. Emsen, E., Yaprak, M.: The effect of vitamin E + Se and exogenous hormone treatments on fertility of Awassi and Redkaraman ewes, growth and viability of their lambs. In: Fourth National Animal Congress, Isparta, 2004; 1: 68–74 (in Turkish).
17. Kul, S., Akçan, A.: İvesi ve Ost-Friz × İvesi Melez (F1) kuzularda büyüme, yaşama gücü ve bazı vücut ölçüleri. Uludağ Univ. J. Fac. Vet. Med., 2002; 21: 109–114.
18. Pollott, G.E., Gürsoy, O., Kirk, K.: The genetics of milk and meat production in Turkish Awassi sheep. In: Proceedings of the 6th World Congress on Genetics Applied to Livestock Production. Armidale, Australia. 11–16 January 1998; (24): 177–180.
19. Kridli, R.T., Abdullah, A.Y., Shaker, M.M., Al-Smadi, N.M.: Reproductive performance and milk yield in Awassi ewes following crossbreeding. Small Ruminant Res., 2007; 71: 103–108.
20. Hassen, Y., Sölkner, J., Fuerst-Waltl, B.: Body weight of Awassi and indigenous Ethiopian sheep and their crosses. Small Ruminant Res., 2004; 55: 51–56.
21. Esenbuğa, N., Dayıoğlu, H.: Effects of some environmental factors on growth traits of Awassi and Redkaraman lambs. Turk. J. Vet. Anim. Sci., 2002; 26: 145–150.
22. Dikmen, S., Turkmen, I.I., Üstüner, H., Alpay, F., Balcı, F., Petek, M., Ogan, M.M.: Effect of weaning system on lamb growth and commercial milk production of Awassi dairy sheep. Czech J. Anim. Sci., 2007; 52: 70–76.
23. Özbey, O., Akçan, A.: Production performance of Morkaraman, Akkaraman and Awassi sheep under semi-intensive conditions II. Growth and survival rates of lambs. Veteriner Bilimleri Dergisi, 2001; 17: 57–66 (article in Turkish with an abstract in English).
24. Aksakal, V., Macit, M., Esenbuga, N.: Effect of various ages of weaning on growth characteristics, survival rate and some body measurements of Awassi lambs. J. Anim. Vet. Adv., 2009; 8: 1624–1630.
25. Ceyhan, A., Sezenler, T., Erdoğan, İ., Hanoğlu, H., Torun, O.: The improvement studies on mutton sheep for Marmara region conditions: I. Fertility, lamb survival, and growth traits of lambs. Turk. J. Vet. Anim. Sci., 2011; 35: 79–86.
26. Özsoy, M.K., Vanlı, Y., Akbulut, Ö.: Effects on some factors on ewe productivity in Awassi and Morkaraman crossbreeding. 1. Reproduction. Turk. J. Vet. Anim. Sci., 1987; 11: 46–58.
27. Hamdon, M.Y.: A study of reproductive performance of Awassi sheep. MSc. College of Agriculture and Forestry, University of Mosul, Iraq. 1980.
28. Gootwine, E., Braw-Tal, R., Bor, A., Goot, H., Shalhevet, D., Zenou, A.: Lamb and milk production in Awassi, Assaf, Boorola–Awassi and Boorola–Assaf sheep in Israel. Proc. N. Z. Soc. Anim. Prod., 1992; 52: 203–205.
29. Kassem, R.: Sheep production improvement and development in Syria. In: Proceedings of the Symposium on the Development of Sheep and Goat Production in the Mid-Eastern Arab Countries, Jordan. 15–17 March 1998; 115–125.