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Growth Performance and Survival Rates in Romanov Lambs

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The aim of this study was to determine the growth performance and survival rates in Romanov lambs (n=57) reared under a semi-intensive management system in Siirt province of Turkey. The live weights (LWs) of the lambs at birth and on days 30, 60, 90, 120, 150 and 180 were determined to be 3.09, 7.57, 15.75, 22.06, 26.79, 29.53 and 31.45 kg, respectively. The average daily live weight gains (ADGs) from birth to the 60th day, from the 61st to 90th days, from the 91st to 180th days, and during the overall period (from birth to 180 days) were 213.18, 205.91, 104.01 and 158.02 g, respectively. The survival rates of the lambs on the 60th, 90th and 180th day were 85.96, 82.46 and 80.70%, respectively. The dams' age (except for during 61-90th days for ADG), sex (except for ADG during 91-180th days), and birth type (only birth weight, LW on 30th day and ADG during 1-180th days) were significant effect on the LWs and ADGs of the lambs (P<0.05); however, the effect of the weaning times was not significant on LWs and ADGs (except for during 61-90th days) (P>0.05), furthermore, the effect of birth type was significant on the survival rate on 180th day among all periods (P<0.05). Consequently, Romanov lambs may be weaned on the 60th day of age; early weaning management will facilitate lambing three times in 2 years in order to obtain more lambs, in addition to increasing the amount of milk obtained for commercial purposes.

Key Words: *Growth, Romanov, Siirt, survival rate, weaning time*

Romanov Kuzularının Büyüme Performansı ve Yaşama Gücü

Bu araştırmanın amacı, Türkiye'nin Siirt ilinde yarı-entansif koşullarda yetiştirilen Romanov kuzularının (n=57) büyüme performansı ile yaşama gücünü belirlemektir. Kuzuların doğum, 30, 60, 90, 120, 150, ve 180. gün canlı ağırlıkları (CA) sırasıyla 3.09, 7.57, 15.75, 22.06, 26.79, 29.53 ve 31.45 kg; doğum-60, 61-90. gün, 91-180. gün ve doğum-180 arası dönemde günlük canlı ağırlık artışı (GCAA) sırasıyla 213.18, 205.91, 104.01 ve 158.02 g; 60, 90 ve 180. günde yaşama gücü sırasıyla %85.96, 82.46 ve 80.70 olduğu belirlenmiştir. Kuzuların CA ve GCAA üzerine; ana yaşının (61-90. gün arası dönemdeki GCAA hariç), cinsiyetin (91-180. gün arası dönemdeki GCAA hariç) ve doğum tipinin (sadece doğum ağırlığı, 30. gündeki CA ve 1-180. gün arası dönemdeki GCAA) etkisinin önemli olduğu (P<0.05), buna karşın farklı zamanlarda sütten kesme programı uygulamasının ise CA ve GCAA (61-90. gün arası dönem hariç) üzerine etkisinin istatistiksel olarak önemli olmadığı belirlenmiştir (P>0.05). İncelenen tüm faktörler ve dönemler içinde ise sadece doğum tipinin 180. gündeki yaşama gücü üzerine etkisinin önemli olduğu tespit edilmiştir (P<0.05). Sonuç olarak; daha fazla yavru elde etmek için koyunlara 2 yılda 3 kez kuzulatma programının uygulanmasına ve koyunlardan ticari amaçla elde edilen süt miktarının artırılabilmesine imkan sağlayabileceğinden dolayı Romanov ırkı kuzuları 60 günlük yaşta sütten kesilebilir.

Anahtar Kelimeler*:* *Büyüme, Romanov, Siirt, yaşama gücü, sütten kesim yaşı*

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Introcution

The global number of sheep have been continuously increasing, and breeding from ewe lambs is attracting more interest in many regions of the world. Prolificacy and economic profit in sheep/lamb breeding depends on litter size, live weights (LWs) of the lambs, growth performance, survival rate (the number of lambs at birth, at weaning, and at different ages) and the carcass yield (1).

While high-yield sheep breeding is integrated with modern breeding systems in most developed countries, low-yield indigenous breeds are typically raised with traditional systems in Middle Eastern countries, in some Mediterranean countries and in Turkey, countries that are still developing. Although indigenous sheep breeds such as the White-Karaman, Red-Karaman, Daglic, Kivircik and Awassi are commonly raised in Turkey, other breeds, including the Romanov, Ost Friz, Texel, Rambouillet, Dorper and Ile de France, that have a higher yield (high reproductive performance, milk and meat yields) are also reared in certain areas in restricted in terms of number (2, 3).

Romanov sheep have the ability to give birth to 4-6 lambs at once; however, the average litter size is 2.7 Romanov sheep are characterized by early sexual maturity (3-4 months of age), and the lambs may be used at a relatively early age (generally at 7-8 month of age) for mating, when compared with other sheep breeds. In addition, this breed has high prolificacy and out-of-season breeding ability, and can reproduce at a rate of approximately three times in 2 years (lambing every 8 months with different weaning management strategies) (4, 5).

Romanov lambs enable breeders to breed sheep in an economical and profitable manner, due to their capacity for early development and early breeding, their high survival rate, high adaptation capacity, and high reproductive performance. The growth performance, which is one of the indicators of early development, and the survival rate of the lambs are each affected by both genetic and non-genetic factors. Non-genetic factors include feeding behavior (suckling or nutrition), housing- and management-conditions (different weaning management, etc.), age, birth weight, birth type, LW, climate (including ambient temperatures), disease and sex.

Early weaning involves the weaning of lambs earlier than the regular suckling period and/or separating them from their dam. Increasing the productivity and profitability of sheep breeding is possible with early weaning, including placing the sheep in accelerated lambing programs, and obtaining sheep milk as early as possible for commercial selling (6). Several criteria (age, LW and daily feed consumption, etc.) play significant roles in the early weaning of lambs. It is necessary to find the optimal weaning age for lambs, as early weaning can lead to stress and a decline in growth performance, and cause health problems (7).

Previous studies reported that weaning lambs at 8 weeks has no significant negative effect on growth and reproductive performance (7). However, several other studies have reported that weaning may be conducted as early as 4-6 weeks (8). Lambs in Turkey are generally weaned after 90 days; however, in some areas, lambs may be weaned between 45 and 90 days, in order to obtain more sheep milk (3, 9).

Studies conducted on Romanov sheep breeding, a species that have adapted to the cold and to other climatic conditions, are limited regarding those raised in Turkey. In addition, there are inadequate data concerning the yields of Romanov sheep reared in moist sub-humid (C2) climatic conditions. The present study was conducted with the following aims: (i) to determine the optimum weaning time; (ii) to determine the effects of non-genetic factors, on the growth performance and survival rate of Romanov lambs; and (iii) to present data that may be of benefit to sheep producers in the country.

Materials and Methods

This study was performed on animals according to the institutional committee on animal use (protocol number 2017/04/01). This study was conducted in a flock (located latitude 37°58'06.7"N, longitude 41°50'12.9"E) in farm conditions between February and September 2017 at the Siirt University Application and Research Farm in Siirt Province, where the altitude is 920 meters, which has a moist sub-humid climate (C2, B'3, s2, b'2), according to the Thornthwaite climate grading system (10). The average rainfall is 715.4 mm per annum. The average maximum and minimum temperatures typically range from 23.4 to 37.0 ^{0} C in the summer months, and -0.6 to 8.7 ^{0} C in the winter months.

The study was carried out with 57 Romanov lambs (from 31 ewes and 3 rams) raised in semi-intensive conditions. Free-mating system was applied. Matings started in August 2016. Lambing started generally in mid-February and lasted until the end of March. Birth weights of lambs were measured and recorded within 24 hours after lambing using a scale with 20-g sensitivity and the lambs were numbered with plastic ear tags. Sex and birth type of lamb, dam and ram identification numbers were recorded. Subsequently, the LWs of the lambs were recorded at monthly intervals, and the LWs of lambs on days 30, 60, 90, 120 and 180 after birth were calculated by linear interpolation. The ADGs of lambs between the birth-60th day, 61-90th days, 91-180th days, and birth-180th day (overall) growth periods were calculated. In order to determine the survival rates, the percentage of lambs alive on days 60, 90 and 180 post-birth was used.

The lambs were kept with their mothers in the morning (06:00-08:00) and at night (18:00-20:00), and were given *ad libitum* alfalfa hay and lamb-grower feed (approximately 100 g per lambs per day) (dry matter, metabolic energy, crude protein, crude fat, crude fibre and crude ash were 89.60%, 2789 kcal/kg, 17.99%, 4.88%, 5.12% and 6.00%, respectively) during the suckling period, until the 60th (Weaning60) or 90th (Weaning90) day after birth. The lambs in Weaning60 and Weaning90 groups were weaned on day 60 and 90, respectively. After the suckling period, the lambs were grazed in the rangelands from 8.00 to 17.00 hours, and 250 g concentrated feeds (dry matter, metabolic energy, crude protein, crude fat, crude fibre and crude ash were 89.62%, 2699 kcal/kg, 16.20%, 2.71%, 6.06% and 5.16%, respectively) were given daily to the lambs as additional nutrients.

The effects of growth traits such as weaning time, age of dam, sex, birth type and birth weight were evaluated using Least Squares Method. The cumulative general linear models were utilized for determination of birth weight, $Y_{ijklm}= \mu+W_i+A_j+B_k+S_l+e_{ijklm}$; for determination of LW and ADG at different growth periods, $Y_{ijklm}= \mu+W_i+A_j+B_k+S_l+b(\overline{X}_{ijkl}-\overline{X})+e_{ijklm}$ where; Y: birth weight or live weight or daily live weight gain of any lambs at a given time, μ: mean of population for examined trait, W_i: the effect of weaning time (i: 60th and 90th days), A_j: the effect of dam age (j: 2, 3 and 4 year old), B_k: the effect of birth type (k: single, twin and triplets), S_l: the effect of sex, (l: male and female), b: fractional regression of birth weight or LW or ADG of any lamb at a given time to birth weight of lamb, e_{ijklm}: error term. Different body measurements of lambs at different periods were analyzed using GLM procedures of Sas Statistical Software (11). Duncan's multiple range tests were used for multiple comparisons between subgroups. The Chi-squared method, conducted using the SPSS statistical software package (12), was utilized for comparing the survival rate of lambs at weaning and on day 180.

Results

In this study, the LWs of the lambs were 3.09, 7.57, 15.75, 22.06, 26.79, 29.53 and 31.45 kg at birth and at days 30, 60, 90, 120, 150, 180, respectively (Tables 1, and 2). The ADGs from birth to the 60^{th} day, from the 61^{st} to 90^{th} days, from the 91^{st} to 180^{th} days, and during the overall period (from birth to 180 days) were 213.18, 205.91, 104.01 and 158.02 g, respectively (Table 3). The survival rate of the Romanov lambs on the 60^{th}, 90^{th} and 180^{th} days were average 85.96%, 82.46% and 80.70%, respectively (Table 4). It was determined that weaning on the 60^{th} or 90^{th} days in lambs was not significantly effect on the LWs, ADGs (except for 61-90^{th} days), and survival rates (P>0.05) in the periods that were included in the study.

Tablo 1. Effect of non-genetic factors on live weights between birth and 90^{th} day in Romanov lambs

Factors	n	Birth	n	30^{th} day	n	60^{th} day	n	90^{th} day
Weaning group								
Weaning60	31	2.99±0.11	29	7.50±0.26	26	15.73±0.41	26	21.33±0.49
Weaning90	26	3.19±0.14	24	7.64±0.34	23	15.77±0.52	21	22.79±0.65
P-value		0.1945		0.7003		0.9648		0.0574
Age of dam, years								
2	16	2.49±0.15^{b}	16	6.85±0.38^{b}	13	14.47±0.63^{b}	13	19.95±0.78^{b}
3	23	3.27±0.14^{ab}	21	7.35±0.36^{ab}	20	15.48±0.54^{b}	19	22.15±0.65^{ab}
4	18	3.51±0.16^{a}	16	8.51±0.43^{a}	16	17.30±0.66^{a}	15	24.08±0.80^{a}
P-value		<.0001		0.0183		0.0132		0.0064
Sex								
Female	25	2.84±0.14	22	7.22±0.34	21	14.90±0.52	19	20.90±0.64
Male	32	3.34±0.10	31	7.92±0.29	28	16.60±0.44	28	23.22±0.55
P-value		0.0029		0.0115		0.0150		0.0069
Birth type								
Single	9	4.51±0.20^{a}	9	8.29±0.75^{a}	9	16.99±1.14	9	23.74±1.35
Twin	36	2.59±0.09^{b}	34	7.34±0.24^{b}	30	15.18±0.39	30	20.82±0.49
Triplet	12	2.17±0.19^{b}	10	7.08±0.52^{b}	10	15.08±0.83	8	21.62±1.03
P-value		<.0001		0.0332		0.4082		0.1236
Linear regression								
Birth weight		---		1.5±0.21		2.04±0.32		2.65±0.41
P-value				0.0001		0.0001		0.0001
Overall	57	3.09±0.13	53	7.57±0.27	49	15.75±0.42	47	22.06±0.55

$^{a, b}$: Means with different superscripts in the same column differ significantly (P<0.05).

Values represent least squares means ± standard errors.

Tablo 2. Effect of non-genetic factors on daily live weight gain in Romanov lambs

Factors	n	120^{th} day	n	150^{th} da	n	180^{th} day
Weaning group						
Weaning60	26	26.35±0.54	25	29.09±0.53	25	31.04±0.62
Weaning90	21	27.23±0.72	21	29.97±0.69	21	31.86±0.81
P-value		0.2886		0.2848		0.3926
Age of dam. years						
2	13	24.39±0.87^{b}	12	26.78±0.85^{b}	12	28.28±1.00^{b}
3	19	27.06±0.72^{ab}	19	29.68±0.70^{b}	19	31.30±0.81^{b}
4	15	28.92±0.89^{a}	15	32.13±0.86^{a}	15	34.77±1.00^{a}
P-value		0.0080		0.0010		0.0004
Sex						
Female	19	25.52±0.71	19	28.08±0.70	19	30.09±0.82
Male	28	28.06±0.60	27	30.98±0.60	27	32.81±0.69
P-value		0.0076		0.0029		0.0146
Birth type						
Single	9	28.87±1.50	9	31.73±1.46	9	34.90±1.70
Twin	30	25.19±0.54	30	28.24±0.53	30	29.96±0.62
Triplet	8	26.31±1.15	7	28.62±1.13	7	29.49±1.32
P-value		0.0603		0.1224		0.0643
Linear regression						
Birth weight		2.63±0.45		2.72±0.46		2.64±0.52
P-value		0.0001		0.0001		0.0001
Overall	47	26.79±0.57	46	29.53±0.59	46	31.45±0.63

$^{a, b}$: Means with different superscripts in the same column differ significantly (P<0.05).

Values represent least squares means ± standard errors.

Table 3. Effect of non-genetic factors on daily live weight gain in Romanov lambs

Factors	Birth-60 d	61-90 d	91-180 d	Overall growth rate
Weaning group				
Weaning60	212.95±6.77	183.99±8.00	106.76±4.37	155.74±3.43
Weaning90	213.41±8.62	227.84±10.56	101.27±5.73	160.30±4.49
P-value	0.9647	0.0009	0.4182	0.3926
Age of dam. years				
2	191.90±10.50[b]	178.05±12.81	93.68±7.04[b]	140.39±5.53[b]
3	208.72±9.00[ab]	219.15±10.58	99.92±5.76[b]	157.19±4.52[b]
4	238.92±10.95[a]	220.54±13.14	118.44±7.08[a]	176.48±5.56[a]
P-value	0.0132	0.0651	0.0324	0.0004
Sex				
Female	199.02±8.72	196.14±10.49	103.63±5.80	150.46±4.55
Male	227.34±7.38	215.69±8.93	104.40±4.91	165.58±3.86
P-value	0.0150	0.0494	0.9194	0.0147
Birth type				
Single	203.69±6.51	186.43±7.95	101.31±4.37	177.18±9.43[a]
Twin	233.84±19.00	221.74±22.17	121.43±12.02	149.77±3.43[b]
Triplet	202.01±13.75	209.57±16.94	89.30±9.32	147.11±7.32[b]
P-value	0.4082	0.1258	0.2145	0.0443
Linear regression				
Birth weight	17.35±5.40	20.31±6.61	0.04±3.17	9.14±2.879
P-value	0.0025	0.0037	0.9886	0.0027
Overall	213.18±5.59	205.91±6.90	104.01±3.04	158.02±3.06

[a, b]: Means with different superscripts in the same column differ significantly (P<0.05).
Values represent least squares means ± standard errors.

Table 4. Survival rates of lambs at different ages (%)

Factors	60th day	90th day	180th day
Weaning group			
Weaning60	83.87	83.87	80.65
Weaning90	88.46	80.77	80.77
Chi-Square	0.247	0.940	0.000
P-value	0.715	0.759	0.991
Age of dam. years			
2	81.25	81.25	75.00
3	86.96	82.61	82.61
4	88.89	83.33	83.33
Chi-Square	0.441	0.260	0.468
P-value	0.802	0.987	0.791
Sex			
Female	84.00	76.00	76.00
Male	87.50	87.50	84.38
Chi-Square	0.143	1.283	0.632
P-value	0.720	0.308	0.508
Birth type			
Single	100.00	100.00	100.00[a]
Twin	83.33	83.33	83.33[ab]
Triplet	83.33	66.67	58.33[b]
Chi-Square	1.745	4.002	6.167
P-value	0.418	0.135	0.046
Overall	85.96	82.46	80.70

[a, b]: Means with different superscripts in the same column differ significantly (P<0.05).

Age of the dam had important effect on the LWs and ADGs of the lambs in all periods (except for 61-90th days for ADG) (P<0.05), it was not influential on the survival rates (P>0.05); and in addition, the lambs whose mothers' age was four had higher LW and ADG than the other dam age groups. It was also determined that sex was statistically effect on the LWs and ADGs (except for 91-180th days) in all periods (P<0.05), but it had no effect of survival rates (P>0.05); moreover, male lambs had higher LW and ADG than female lambs.

The birth type had an effect on LWs (at birth and on 30th day), ADG (from birth to 180 day) and the survival rate (on 180th day) (P<0.05), and it was also determined that the multiple births in the lambs caused decrease in these characteristics.

Discussion

In this study, we determined that as the age of the dam increased, so did the birth weights of the lambs, and the highest birth weights were recorded for lambs born from 4-years-old dams (Table 1). Lambs from immature ewes would also be smaller at birth due to the mother having an underdeveloped uterus, and need more of the nutrients for her own continued growth and development as well. Since the reproductive organs of the primiparous ewes are less developed, the physiology of the dam likely limits the fetal size. In addition, immature ewes have a constant competition between the nutrients needed for the growth of the fetus and those required to sustain the life of the mother during pregnancy, in which this will be even more pronounced in sheep breeds that produce multiple lambs, such as the Romanov (13, 14).

In this study, the male lambs had higher birth weights than the female lambs. These results are consistent with those of previous studies conducted by Aktas et al. (15). Since the existence of the Y-chromosome and the products of SRY (Sex determining Region on chromosome Y) gene activation have gender-specific effects on the growth of the fetus, it causes differences in the chromosomal structure during prenatal growth, which eventually affects skeletal development. For this reason, male fetuses grow faster than females in the uterus (13). In a prior study, the effects of sex-related genes on the birth weights of Landrace piglets were investigated; it was reported that, although the Y-chromosome contributed greatly to genetic changes in birth weights, the X chromosome did not have a significant effect on birth weights (16). This situation, in which Y or X chromosome-related locus activation is involved, was also reported for other species (17). However, there is a research reporting that sex does not affect birth weight in lambs (18).

In the present study, the highest birth weight was recorded for a single birth; as the litter size increased, the birth weights decreased. This is likely associated with the limited capacity of the uterus and/or malnutrition of the dam during pregnancy. In addition, the reduced quantity of nutrients carried in the blood during the prenatal period, and the decreased number of caruncles connected to each fetus may cause the birth weight to be reduced in multiple-birth lambs (19).

In the current study, different suckling and nutrition programs were not applied to the lambs between birth and the 60th day; thus, there were no significant differences between the Weaning60 (lambs weaned on 60 d old) and Weaning90 (lambs weaned on 90 d old) groups in terms of LWs in this period. Applying different weaning management strategies did not affect the LWs of the lambs at the 60th and 90th days of age. When the LWs of the lambs were analyzed on the 90th day, the lambs in the Weaning90 group had a higher weight than those in the Weaning60 Group. This result is consistent with the results reported by Hanford et al. (20), claiming that high birth weights increased the weaning weights in lambs. While changes in the amount of milk produced by the dam have direct effects on the weaning weight of the lambs, nutritional differences in the dam in the last weeks of pregnancy have indirect effects on the weaning weight of the lambs (21).

In the present study, it was also determined that as the age of the dam increased, so did the LWs of the lambs on the 60th and 90th days postpartum. This could be due to differences in milk supply and maternal care, since primiparous ewes produce less milk than the average and lack the experience to take care of their lamb. It is expected that in older sheep, having a superior maternal environment will contribute to better growth performance in the lambs during the birth-weaning period (22). The mammary glands of 2-years-old sheep are not well developed, which may cause reduced milk production and eventually lead to low weaning weights in lambs (23).

In the present study, male lambs had higher LWs on the 60th and 90th days, compared with female lambs. This stems from the physiological differences between the sexes (24). The differences between male and female lambs reflect the hormonal differences, and may also stem from differences in nutritional requirements. The mechanisms that control the excretion of Growth Hormone (GH) are sexually dimorphic (25). Gatford et al. (25) reported that the speed of prepubertal growth in lambs was affected by IGFPB-3 (protein-based insulinase growth factor), IGF-I (insulin-like growth factor) and GH levels in the blood. Mean plasma GH concentrations, GH pulse amplitude, and integrated plasma GH concentrations were greater in rams than in ewes at a variety of ages.

Researchers have concluded that the differences in GH, IGF-I and IGFBP-3 concentrations may stem from the effects of steroid hormones during sexual differentiation in the prepubertal period. Steroids, like testosterone and estrogen, affect the growth of males and females in different ways. While great amounts of testosterone are produced in males, the production of estrogen and progesterone is dominant in females. Testosterone stimulates muscle development by affecting protein synthesis/decomposition and net protein gain/loss in muscles. In addition, high estrogen levels in the blood limit the growth of long bones and affect body size in females (26).

In this study, it was determined that increased litter size did not affect LWs recorded on the 60th and 90th days. The effect of litter size or birth type decreases as the age of the dam increases. This situation could result from increased milk production as the sheep ages, which eventually allows multiple-birth lambs to have adequate milk. In addition, the effect of birth type decreases as the lamb ages, and even disappears during the weaning period. This may be associated with the transition to normal feeding patterns when they start to feed on roughage and concentrated feed.

The application of different weaning management strategies and variation in birth types did not affect the LWs of the lambs on the 180th day (Table 2). It was determined that, as the age of the dam increased, the LW on the 180th day increased, and the highest LWs were recorded for the lambs born to 4-year-old ewes. It was also determined that the male lambs had higher 180th day LWs, compared with the female lambs (Table 2). The heavier body weight of male lambs may be due to the variation in their endocrine profile, and in their culling level practiced at different ages (27). Most likely, this phenomenon can be explained by increased testosterone secretion in growing ram lambs.

The lambs in the Weaning90 group had a higher ADG than the lambs in the Weaning60 group during the period between 61 and 90 days of age (Table 3). This may be due to malnutrition in the 1-month period after weaning, a lack of adequate rumen development, or the stress of weaning. Overall, the growth performance did not decrease in lambs weaned on the 60th day, when compared with those weaned on the 90th day.

In the present study, increased dam age caused the growth performance of lambs to also increase between birth and the 60th day, between the 90th and 180th days, and overall. Prior study showed that the growth performance of lambs born to older ewes was higher (28). The lowest growth performance was in lambs born to 2-year-old dams, which may be associated with the fact that mammary gland development in 2-year-old ewes is not sufficient to produce enough milk for their lambs (29). This may be because young ewes that have not reached adult size continue to grow, thus muscle synthesis is competing with milk synthesis for available nutrients, and less milk is available for suckling lambs. With an increase in parity, milk yield also increases. In addition, as the sheep ages, the body size increases, thus more milk is produced (30). In addition, immature dams are less experienced in raising lambs compared with multiparous dams (31).

In the present study, male lambs had a higher ADG than female lambs in the periods from birth to the 60th day, from the 90th to 180th days, and overall. The notable effects of sex differences on growth may arise from physiological properties and endocrine profiles (32). Therefore, female lambs have a lower growth performance than male lambs (21).

In this study, the highest ADGs were recorded for single-birth lambs, for the overall period. This may be due to a single-birth lamb receiving more milk from their dam, compared with multiple-birth lambs, thus better covering their nutritional needs.

The age of the dam did not have a significant effect on the survival rate of the lambs by the 60th, 90th and 180th days (Table 4). This finding is contrary to the results reported by Vostrý and Milerski (33) in Romanov lambs, whereas it is in agreement with those reported by Vatankhah and Talebi (34) in Lori-Bakhtiari lambs.

The application of different weaning management strategies, and the sex of the lambs, did not have any significant effects on the survival rates of the lambs on the 60th, 90th and 180th days. However, the survival rate of single-birth lambs on the 180th day was higher than that for multiple-birth lambs. Yet, the reduced survival rate associated with multiple-birth lambs is not sufficient to offset the advantage of extra lambs (35).

In the present study, it was determined that weaning Romanov lambs on the 60th day instead of the 90th day did not negatively affect the LW, growth performance and survival rate. In addition, although the Romanov sheep breed is adapted to cold conditions, it may also be successfully raised in moist sub-humid conditions. In conclusion, it may be recommended that Romanov lambs be weaned on the 60th day of age, as an early-weaning management strategy will enable lambing three times in 2 years, thus obtaining more lambs, and increase the amount of milk available for commercial use.

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