

The effect of birth type and gender on growth performance, live weight gain, growth pattern modeling, and survival rate in Anatolian Merino lambs

Research Article

ABSTRACT

In this study, the aim was to determine the effect of birth type and gender on growth performance, live weight gain, growth modeling, and survival rate in Anatolian Merino lambs. Growth performance was determined in 28 singletons (14 females/14 males), 80 twins (38 females / 42 males), and 54 triplets (22 females / 32 males) lambs in the study. The body weight of the lambs was measured on the day of birth (day 0), and at 10, 20, 30, 45, and 60 days of age. Birth type was effective on growth performance in Anatolian Merino lambs ($P < 0.001$). The effect of gender on growth performance was significant at 30 days of age and beyond ($P < 0.05$). Except for the period between 0-20 days, the effect of birth type was statistically significant for all other measurement days on daily live weight gain until the day of measurement ($P < 0.05$). However, gender influenced daily live weight gain between 0-45 days and 0-60 days ($P < 0.05$). Survival rates up to 60 days of age in Anatolian Merino lambs was not statistically different according to birth type and gender ($P > 0.05$). The total survival rate was 95.3%. In growth modeling of Anatolian Merino lambs, the highest regression value was in singleton males ($r^2 = 0.910$), and the lowest r^2 value was in triplet males ($r^2 = 0.746$). In conclusion, birth type may affect the growth performance and daily live weight gain of Anatolian Merino lambs. Moreover, the similar survival rate according to birth types indicates that this productive breed is both productive and has high survivability.

Keywords: Anatolian Merino, growth performance, lambs, live weight gain, survival

INTRODUCTION

Given Türkiye's geographical conditions, sheep farming stands out as a significant livestock production activity, both culturally and economically. Sheep effectively utilize poor pastures and convert them into economically valuable animal products. Consequently, sheep farming generates economic benefits for family-type farms engaged in this activity (Boğa Kuru & Kuru, 2022; Kaymakçı, 2016; Kırbaş et al., 2022; Koyuncu, 2019; Turgut et al., 2023; Yılmaz et al., 2022). According to the Turkish Statistical Institute (TÜİK) data for 2023, there are 42,060,470 sheep in Türkiye (TÜİK, 2023).

Anatolian Merino carries 80% German Mutton Merino and 20% White Karaman genotype. Generally, it is raised in Central Anatolia. Anatolian Merino, which is a meat-wool dual-purpose breed, is one of Türkiye's strong local sheep breeds that adapts well to pasture conditions and flock management. Females are polled, while males may have horns. Female mature body weight ranges from 30 to 78 kg (average 55 kg), while males mature to 80-90 kg. Birth weight in Anatolian Merino lambs

Buket Boğa Kuru^{1a}
Veli Ölmez^{2b}

¹ Department of Animal Breeding and Husbandry, Faculty of Veterinary Medicine, Kafkas University, Kars, Türkiye,
² Sanvet Veterinary Clinic, Afyonkarahisar, Türkiye

ORCID-

^a[0000-0002-7170-270X](https://orcid.org/0000-0002-7170-270X)

^b[0009-0003-7794-8035](https://orcid.org/0009-0003-7794-8035)

Correspondence

Buket Boğa Kuru

buket.kuru@kafkas.edu.tr

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ranges from 2.1 to 6 kg in males (with an average of 4.5 kg) and from 2 to 6.0 kg in females (with an average of 4 kg). These sheep do not face many infertility problems, and their lambing rate is 1.3. Survival rates in lambs from birth to weaning and to puberty are 85% and 83.7%, respectively (Alçayır & Karabacak, 2019; Boğa Kuru et al., 2024; Resmi Gazete, 2004; TAGEM, 2009).

Birth weight in lambs is an important criterion for the profitability of enterprises (Habtegiorgis et al., 2022; Odabaşoğlu, 1990). Furthermore, birth weight in lambs can significantly influence survival rate by directly affecting growth and growth traits (Akçapınar, 1994; Kaymakçı, 2016; Koyuncu, 2019; Öztürk et al., 2018). A decrease in birth weight can lead to an increase in lamb mortality. The average birth weight of lambs generally ranges from 3 to 5 kg (Akçapınar, 1994; Alçayır & Karabacak, 2019; Ceyhan et al., 2015; Koyuncu, 2019; Odabaşoğlu, 1990; Schreurs et al., 2010). There are many factors that affect birth weight, such as feeding, birth type, maternal age, breed, and season (Akçapınar, 1994; Alçayır & Karabacak, 2019; Dellal, 2002; Karakuş, 2023; Sveinbjörnsson et al., 2021).

Growth in animal husbandry is defined as an increase in animals' body measurements, particularly their live weight (Aytekin et al., 2009; Lamy et al., 2012). Mature live weight is recognized as a crucial criterion for evaluating animals' growth and developmental characteristics (Castillo et al., 2023; Koyuncu, 2019; Topal et al., 2004). While a higher mature live weight is desirable, it can also bring about drawbacks like birthing difficulties and increased expenses. Therefore, it is essential to regulate growth rates in accordance with the intended purpose, considering factors such as animals' genotypic makeup and nutrition (Aytekin et al., 2009; Lamy et al., 2012; Owens et al., 1993; Topal et al., 2004).

The aim of this study was to determine the effects of birth type and gender on growth performance, live weight gain, growth pattern modeling, and survival rate in Anatolian Merino lambs.

MATERIALS AND METHODS

Ethical approve

This study commenced following approval from the Animal Experiments Local Ethics Committee of Kafkas University (KAÜ-HADYEK-2024/11), Kars, Türkiye.

Location

The research was conducted at a commercial sheep farm located in the Sandıklı district of Afyonkarahisar province, Türkiye. Sandıklı is situated at 38°27'53.7"N latitude and 30°16'22.7"E longitude, with an elevation of 1095 meters above sea level.

Animals

A total of 170 Anatolian Merino lambs were utilized in the study. Body weights were measured for 162 of these lambs over a 60-day period. Data from 8 lambs that died at different times were not included in the study. Growth performance was determined for 28 single lambs (14 females/14 males), 80 twin lambs (38 females/42 males), and 54 triplet lambs (22 females/32 males).

Housing and feeding

No additional practices were implemented for the housing and feeding criteria of the lambs, and routine care and feeding conditions on the farm were maintained. In addition, the sheep were supplemented with a balanced concentrate formulated to meet their milk yield requirements (NRC, 2007).

Lambs stayed with their mothers in pens for the first 7 days. From the 7th to the 21st day, lambs stayed with their mothers in collective pens for socialization. After the 21st day, lambs

were moved to separate pens. Between the 21st and 45th days, lambs had free access to their mothers through a system called the "kaşak" system, allowing them to consume both mother's milk and feed and water. After the 45th day, lambs stayed with their mothers for 30 min in the morning and evening to encourage them to focus more on feed intake.

Starting from the 15th day, lambs were provided with as much dry hay and starter lamb feed (Şampiyon Kuzu Yemi[®], Emek Yem, Balıkesir) as they could consume. From the 30th to the 60th day, lambs were fed with dry hay, barley, and starter lamb feed. Access to fresh and clean water was provided at all times since the start of feeding lambs.

Measurement of body weight

The body weight of the lambs was measured using a digital scale on the day of birth (day 0), as well as at 10, 20, 30, 45, and 60 days of age.

Statistical analysis

The Shapiro-Wilk test was employed to assess the normality of the data. Subsequently, General Linear Model (GLM) was utilized to investigate the effects of gender and birth type (single, twin, and triplet) on growth performance and live weight gain in lambs. Duncan's multiple comparison test was employed for pairwise comparisons of differences between birth types

at the same time point. To evaluate potential disparities in mortality and survival rates, the chi-square test was implemented, considering the influences of gender and birth type. Linear regression models based on gender and birth type were constructed to elucidate their influence on live weights. Data are presented as mean ± standard deviation (SD). Statistical analyses were conducted using GraphPad Prism[®] (Version 9.5.1, GraphPad Software Inc., San Diego, CA, USA) and SPSS[®] (Version 26.0, SPSS Inc./IBM Group, Chicago, IL, USA) software. A significance level of P < 0.05 was established for group comparisons.

RESULTS

Birth type in Anatolian Merino lambs significantly impacted growth performance throughout all measurement days (P < 0.001). Single lambs had significantly higher live weights compared to both twin and triplet lambs (P < 0.001). Interestingly, twin and triplet lambs exhibited statistically similar growth performance (P > 0.05). The effect of gender on growth became apparent from day 30 onwards (P = 0.027), with significant differences persisting on days 45 (P = 0.001) and 60 (P < 0.001). Table 1 summarizes the changes in live weight observed in Anatolian Merino lambs at birth, and at 10, 20, 30, 45, and 60 days of age, categorized by birth type and gender.

Table 1: Changes in growth performance (kg) of Anatolian Merino lambs according to measurement days, birth type, and gender (mean ± standard deviation).

Items	n	Day 0*	Day 10	Day 20	Day 30	Day 45	Day 60	
Birth type	Single	28	6.27 ± 0.84 ^a	8.10 ± 1.19 ^a	9.95 ± 0.94 ^a	12.73 ± 1.09 ^a	16.01 ± 2.15 ^a	18.95 ± 3.48 ^a
	Twins	80	4.37 ± 0.93 ^b	6.21 ± 1.04 ^b	8.04 ± 1.15 ^b	10.62 ± 1.21 ^b	13.55 ± 2.33 ^b	15.88 ± 3.01 ^b
	Triplet	54	4.36 ± 1.89 ^b	6.55 ± 2.10 ^b	8.16 ± 2.21 ^b	10.17 ± 2.04 ^b	12.54 ± 2.11 ^b	14.74 ± 2.25 ^b
	P value	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Gender	Female	74	4.53 ± 1.50	6.57 ± 1.64	8.33 ± 1.67	10.62 ± 1.77	13.22 ± 2.56	15.31 ± 3.02
	Male	88	4.85 ± 1.48	6.73 ± 1.65	8.48 ± 1.75	11.04 ± 1.73	13.99 ± 2.42	16.63 ± 3.22
	P value	-	0.10	0.47	0.365	0.027	0.001	<0.001
Total	162	4.70 ± 1.49	6.65 ± 1.64	8.41 ± 1.71	10.84 ± 1.75	13.64 ± 2.51	16.03 ± 3.19	

*: Birth weight; ^{a-b}: Within each column, groups with different letters show statistically significant differences from each other.

Birth type significantly influenced daily live weight gain across measurement days, while gender's effect was evident from 20-30 days of age onwards (Table 2). Except for the 0-20-day interval, birth type significantly impacted daily

live weight gain until the final measurement day ($P < 0.05$). Conversely, gender affected daily live weight gain between 0-45 and 0-60 days ($P < 0.05$). Table 2 presents the inter-measurement and age-specific daily live weight gains in Anatolian Merino lambs.

Table 2: Effect of birth type and gender on daily live weight gain (mean \pm standard deviation) in Anatolian Merino lambs.

Daily live weight gain between measurements (g)							
Items	n	Day 0-10	Day 11-20	Day 21-30	Day 31-45	Day 46-60	
Birth type	Single	28	183.2 \pm 53.5 ^b	185.0 \pm 37.6 ^a	277.1 \pm 113.3 ^a	219.3 \pm 131.2 ^a	195.5 \pm 100.3 ^a
	Twins	80	183.6 \pm 47.1 ^b	182.9 \pm 41.2 ^a	258.1 \pm 109.9 ^a	195.0 \pm 120.6 ^a	155.2 \pm 62.8 ^b
	Triplet	54	218.5 \pm 79.1 ^a	160.6 \pm 41.2 ^b	201.1 \pm 60.6 ^b	158.0 \pm 93.2 ^b	146.8 \pm 58.4 ^b
	P value	-	0.001	0.006	0.001	0.047	0.003
Gender	Female	74	203.8 \pm 75.2	176.6 \pm 41.1	229.3 \pm 95.7	173.2 \pm 107.7	139.2 \pm 56.7
	Male	88	188.0 \pm 48.5	175.1 \pm 42.6	253.4 \pm 104.4	198.3 \pm 121.3	176.3 \pm 77.4
	P value	-	0.098	0.404	0.048	0.029	<0.001
Total	162	195.2 \pm 62.5	175.8 \pm 41.8	242.4 \pm 101.0	186.9 \pm 115.7	159.3 \pm 71.0	
Daily live weight gain (g)							
Items	n	Day 0-10	Day 0-20	Day 0-30	Day 0-45	Day 0-60	
Birth type	Single	28	183.2 \pm 53.5 ^b	184.1 \pm 25.0	215.1 \pm 41.3 ^a	216.5 \pm 58.6 ^a	211.2 \pm 65.7 ^a
	Twins	80	183.6 \pm 47.1 ^b	183.3 \pm 32.6	208.2 \pm 38.6 ^{ab}	203.8 \pm 58.4 ^{ab}	191.6 \pm 55.5 ^{ab}
	Triplet	54	218.5 \pm 79.1 ^a	189.5 \pm 45.1	193.4 \pm 32.5 ^b	181.6 \pm 40.6 ^b	172.9 \pm 35.3 ^b
	P value	-	0.001	0.434	0.034	0.012	0.004
Gender	Female	74	203.8 \pm 75.2	190.2 \pm 41.3	203.2 \pm 40.1	193.3 \pm 54.4	179.7 \pm 49.9
	Male	88	188.0 \pm 48.5	181.5 \pm 30.8	205.5 \pm 36.1	203.1 \pm 54.3	196.4 \pm 54.9
	P value	-	0.098	0.353	0.258	0.036	0.002
Total	162	195.2 \pm 62.5	185.5 \pm 36.1	204.5 \pm 37.8	198.6 \pm 54.4	188.8 \pm 53.1	

^{a-b}: Within each column, groups with different letters show statistically significant differences from each other.

Birth type significantly influenced both weekly and monthly live weight gain in Anatolian Merino lambs ($P < 0.05$). Table 3 presents the weekly and monthly live weight changes and their significance levels for Anatolian Merino lambs categorized by birth type and gender. The survival rates up to 60 days of age in Anatolian Merino lambs was not significantly affected by birth type or gender ($P < 0.05$). A total of 8 lambs died throughout the study, resulting in an overall survival rate of 95.3% (Table 4). Table 4 also presents the number of lambs that died, the total mortality rate, and the survival rate by birth type and

gender on the measurement days during the study. Figure 1A-E presents the results of simple linear regression analysis on growth performance data for Anatolian Merino lambs up to 60 days of age, categorized by both gender and birth type. The highest regression value for Anatolian Merino lambs was observed in single males ($r^2 = 0.910$, $P < 0.001$), with the regression equation $Y = 0.2526 * X + 5.507$, where Y represents weekly growth performance and X represents days (Figure 1A). In terms of birth type, singles ($r^2 = 0.851$) again had higher regression values compared to twins ($r^2 = 0.833$) and triplets ($r^2 = 0.736$) (Figure 1E).

Anatolian Merino lamb growth: Birth type, gender, and survival

Table 3: Effect of birth type and gender on weekly and monthly live weight gain (mean ± standard deviation) in Anatolian Merino lambs.

Weekly live weight gain (kg)					
Items		n	Week 0-4	Week 4-8	Week 0-8
Birth type	Single	28	1.62 ± 0.32 ^a	1.56 ± 0.85 ^a	1.59 ± 0.49 ^a
	Twins	80	1.58 ± 0.30 ^{ab}	1.33 ± 0.63 ^{ab}	1.44 ± 0.42 ^{ab}
	Triplet	54	1.47 ± 0.25 ^b	1.15 ± 0.46 ^b	1.31 ± 0.27 ^b
	P value	-	0.05	0.011	0.006
Gender	Female	74	1.54 ± 0.31	1.19 ± 0.55	1.36 ± 0.38
	Male	88	1.55 ± 0.27	1.41 ± 0.68	1.48 ± 0.41
	P value	-	0.305	0.001	0.002
Total		162	1.55 ± 0.29	1.31 ± 0.63	1.42 ± 0.40
Monthly live weight gain (kg)					
Items		n	Month 0-1	Month 1-2	Month 0-2
Birth type	Single	28	6.45 ± 1.24 ^a	6.22 ± 3.37 ^a	6.36 ± 1.97 ^a
	Twins	80	6.25 ± 1.16 ^{ab}	5.25 ± 2.49 ^{ab}	5.78 ± 1.66 ^{ab}
	Triplet	54	5.80 ± 0.97 ^b	4.57 ± 1.83 ^b	5.21 ± 1.06 ^b
	P value	-	0.034	0.010	0.004
Gender	Female	74	6.10 ± 1.20	4.69 ± 2.19	5.42 ± 1.49
	Male	88	6.16 ± 1.08	5.62 ± 2.71	5.92 ± 1.64
	P value	-	0.257	0.001	0.001
Total		162	6.13 ± 1.14	5.19 ± 2.52	5.69 ± 1.59

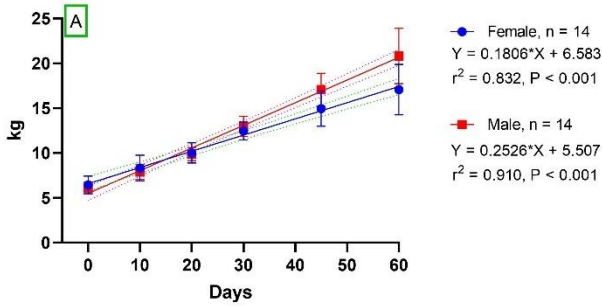
^{a-b}: Within each column, groups with different letters show statistically significant differences from each other.

Table 4: Effect of birth type and gender on mortality count and survival rate of Anatolian Merino lambs by day.

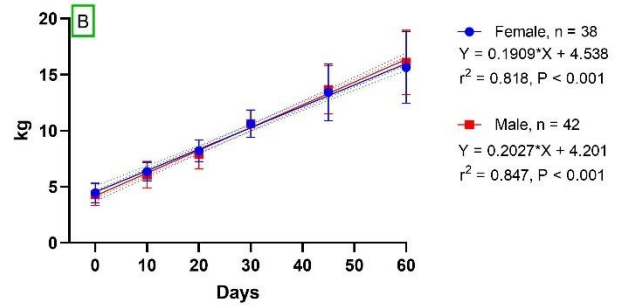
Birth type	Gender	The daily mortality count (n)					Mortality (n / Total n)	Survival rate, % (n / Total n)
		0-10	11-20	21-30	31-45	46-60		
Single	Female	-	-	-	-	-	0/14	100 (14/14)
	Male	1	-	-	-	-	1/15	93.3 (14/15)
	Total	1	-	-	-	-	1/29	96.6 (28/29)
Twins	Female	1	-	1	-	-	2/40	95 (38/40)
	Male	1	-	-	-	1	2/44	97.7 (42/44)
	Total	2	-	1	-	1	4/84	95.2 (80/84)
Triple	Female	1	1	-	-	-	2/24	91.7 (22/24)
	Male	-	-	1	-	-	1/33	96.7 (32/33)
	Total	1	1	1	-	-	3/57	94.7 (54/57)
Total	Female	2	1	1	-	1	5/79	93.7 (74/79)
	Male	2		1	-		3/91	96.7 (88/91)
	Total	4	1	2	-	1	8/170	95.3 (162/170)

Note: There is no statistically significant difference in the intergroup survival rates based on birth type and gender ($P > 0.05$).

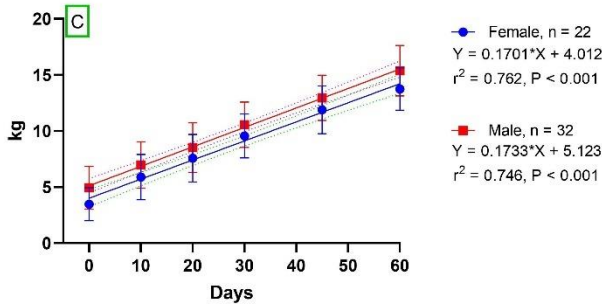
Linear Regression Model For Single Female and Male



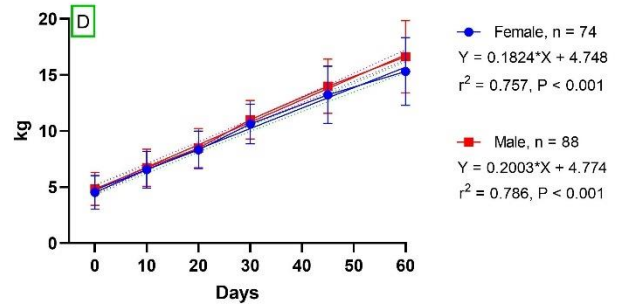
Linear Regression Model For Twin Female and Male



Linear Regression Model For Triplet Female and Male



Linear Regression Model For Total Female and Male



Linear Regression Model For Birth Type

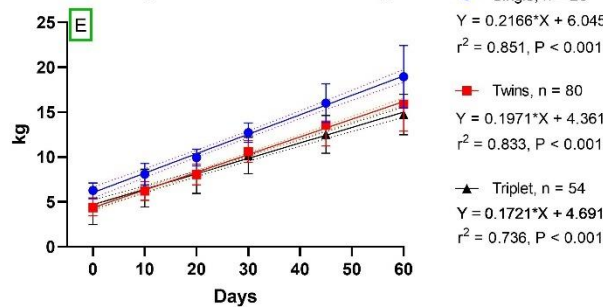


Figure 1: Linear regression models for gender (A-D) and birth type (E) in Anatolian Merino lambs. Y: Live weight, X: Days.

DISCUSSION

In herd management, acquiring body measurement-based data is crucial for monitoring or evaluating the growth and development of farm animals. Particularly in herd management, the methods used to estimate live weight in ruminants must be reliable (Aytekin et al., 2009; Coşkun et al., 2023; Guvenoglu, 2023; Keskin & Dağ, 2006; Tırınk, 2022; Wangchuk et al., 2018). This study aimed to investigate the effects of birth type and gender on growth performance, live weight gain, growth

modeling, and survival rate in Anatolian Merino lambs from birth to 60 days of age, along with the variations in these characteristics across sampling days.

The effect of gender and birth type on growth performance and live weight gain from birth to weaning was determined in Central Anatolian Merino lambs (Aktaş et al., 2016). In Central Anatolian Merino lambs, birth weight and 45-day live weight were 4.71 kg and 14.12 kg for males, and 4.41 kg and 13.33 kg for females. Additionally, mean birth weight and 45-day live

weight in singletons were 5 kg and 4.24 kg, and in twins were 14.52 kg and 13.03 kg. Both gender and birth type influence the growth performance of Central Anatolian Merino lambs (Ünal & Akçapinar, 2001). In another study conducted with Central Anatolian Merino lambs, the birth weight and 45-day live weight of singletons and twins were 4.69 kg - 4.04 kg and 15.5 kg - 12.2 kg for males, and 4.47 kg - 3.81 kg and 14.7 kg and 11.7 kg for female singletons and twins, respectively (Yalçın et al., 1980). In Central Anatolian Merino lambs, the average birth weight was 5.50 kg for singles, 4.47 kg for twins, 5.15 kg for males, 4.64 kg for females, and 4.86 kg overall. The effects of birth type and gender on the same traits were found to be significant (Odabaşoğlu, 1990). In Konya Merino lambs, birth, 30-day, and 60-day live weights were 4.8 kg, 12.5 kg, and 20.2 kg for singles, 4 kg, 9.9 kg, and 16.9 kg for twins, 4.2 kg, 10.6 kg, and 17.7 kg for females, and 4.6 kg, 11.8 kg, and 19.3 kg for males. Overall, singles had significantly higher live weights than twins. Additionally, males were significantly heavier than females at different stages of the study (Aktaş et al., 2013). In Karacabey Merino lambs, the average birth weight for single males, single females, twin males, and twin females was 4.48 kg, 4.32 kg, 4.21 kg, and 4.06 kg, respectively, with 60-day weights of 22 kg, 20.7 kg, 18.5 kg, and 17.9 kg. Moreover, male lambs developed faster than females, and singles grew faster than twins (Oğan, 1994). In this study, Anatolian Merino lamb birth weights and live weights at 30, 45, and 60 days were as follows: for singles, 6.3 kg, 12.7 kg, 16 kg, and 19 kg; for twins, 4.4 kg, 10.6 kg, 13.6 kg, and 15.9 kg; for females, 4.5 kg, 10.6 kg, 13.2 kg, and 15.3 kg; and for males, 4.9 kg, 11 kg, 14 kg, and 16.6 kg. Consistently across studies (Aktaş et al., 2013, 2016; Odabaşoğlu, 1990; Oğan, 1994; Ünal & Akçapinar, 2001; Yalçın et al., 1980), singles had higher live weights than twins on all measurement days. Moreover, male lambs exhibited superior live weights compared to females from 30 days onwards. Additionally, it

was found that environmental factors such as dam age, lamb birth year, gender, birth type, and season could significantly affect lamb weights at various growth stages in Merino lambs (Alçayır & Karabacak, 2019; Yalçın et al., 1980). The live weight results obtained in this study from different Merino sheep breeds (Aktaş et al., 2013; Odabaşoğlu, 1990; Oğan, 1994; Ünal & Akçapinar, 2001; Yalçın et al., 1980) appear to be within similar ranges. However, the presence of triplets in this study has had an effect on the average live weight of both female and male lambs. Nevertheless, significant differences in live weight measurements did not occur at different times for both female and male lambs. Therefore, the presence of triple births in Anatolian Merino lambs does not create a significant disadvantage in terms of live weights and could potentially provide more economic benefits for the farm.

In Central Anatolian Merino lambs, daily live weight gain from birth to weaning, weaning to 120 days, and birth to 120 days was determined to be 191.0 g, 215.3 g, and 200.1 g, respectively. Similarly, during the birth to weaning period, females had a daily weight gain of 184.3 g, males 197.7 g, singles 207.4 g, and twins 174.5 g. In this context, both gender and birth type have an impact on daily live weight gain in Central Anatolian Merino lambs (Aktaş et al., 2016). In a study conducted with Merino lambs, daily weight gain varied between 198-216 g during the 0-30-day period and 224-250 g during the 0-60-day period. Additionally, birth type and gender have been effective on daily weight gain at birth, 15, 30, 45, and 60 days of age (Akmaz et al., 1992). In this study, birth type influenced live weight gain from 0-30, 0-45, and 0-60 days, while gender affected daily live weight gain between 0-45 and 0-60 days. Daily live weight gain from 0-60 days was 211.1 g for singles, 191.6 g for twins, 172.9 g for triplets, 179.7 g for females, and 196.4 g for males. These findings are similar to a study on Orta Anatolian Merino lambs (Aktaş et al., 2016) but lower than those

reported for Merino lambs (Akmaz et al., 1992). Triplet births may have particularly influenced the differences in daily live weight gain. Additionally, nutrition, breed, and birth type could have contributed to varying results in daily live weight gain.

In Central Anatolian Merino lambs, the overall survival rate was approximately 96.5% (Yalçın et al., 1980). In another study, the survival rate of Central Anatolian Merino lambs ranged from 88.7% to 92.6% (average 90.8%) (Aktaş et al., 2016). Additionally, the effect of gender on the 30-day survival rate in Central Anatolian Merino lambs was found to be negligible, while birth type could be influential. However, neither gender nor birth type had an effect on the survival rate at older ages in lambs (Ünal & Akçapınar, 2001). In Karacabey Merino lambs, the 60-day survival rate was determined to be 97.5% (Oğan, 1994). Similarly, in Karacabey Merino lambs, the 90-day survival rate was 92.5% for singles, 93% for twins, and an overall average of 92.9% (Başpınar et al., 1997). In a different study, the survival rate in Karacabey Merino lambs was found to be 97.6% for singles, 94.9% for twins, and 90% for triplets, with the birth type significantly affecting survival (Boztepe, 1994). In Konya Merino lambs, the survival rates ranged from 94.1% to 100% up to 30, 60, and 90 days of age (Aktaş et al., 2013). The survival rates obtained from Anatolian Merino lambs in this study are within the reported ranges for Central Anatolian Merino lambs (Aktaş et al., 2016; Yalçın et al., 1980), Karacabey Merino lambs (Başpınar et al., 1997; Oğan, 1994), and Konya Merino lambs (Aktaş et al., 2013). Additionally, the survival rate of triplets in this study was higher than that reported for Karacabey Merino lambs (Boztepe, 1994), although the difference in the number of days monitored may have influenced these rates. Particularly in multiple births, the mortality rate can be higher due to low birth weight (Koyuncu

& Duymaz, 2017). However, birth type did not affect survival rates in this study, indicating that Anatolian Merino lambs may have robust characteristics and high survival performance. These findings demonstrate that the growth and survival performance of Anatolian Merino lambs are satisfactory. Supporting and increasing the population of this breed as an alternative to cattle farming for red meat production could contribute to both red meat production and lamb meat production. Furthermore, promoting and supporting Anatolian Merino lamb farming could increase employment in rural areas and contribute to the local economy.

In Anatolian Merino lambs, simple linear regression curves can be used to calculate growth curves in two different rearing methods (Aytekin et al., 2009; Keskin & Dağ, 2006). The determination coefficient of the simple linear regression model in Anatolian Merino lambs was found to be high (0.990) (Keskin & Dağ, 2006). In the linear model, the r^2 values for growth curve patterns up to 420 days of age in Kıvrıkcık and Dağlıç lambs were determined as 0.993 and 0.997, respectively (Akbaş et al., 1999). In another study, a linear model with an r^2 value of 0.990 provided a good fit for live weight changes in Akkaraman and Awassi x Akkaraman lambs between 1-29 weeks of age (Kocabaş et al., 1997). In this study, a simple linear regression model was used for Anatolian Merino lambs. The highest r^2 value in the study was for single males (0.910), and the lowest was for triplet males (0.746). The r^2 value we obtained is lower than in previous studies (Akbaş et al., 1999; Keskin & Dağ, 2006; Kocabaş et al., 1997). The observed lower r^2 value in our study compared to previous findings (Akbaş et al., 1999; Keskin & Dağ, 2006; Kocabaş et al., 1997) could potentially be attributed to two main factors: a shorter follow-up period for lamb growth compared to prior studies, and potential variations in the number of lambs included

within each treatment group. Future research endeavors investigating the growth patterns of Anatolian Merino lambs with extended monitoring durations and standardized group sizes could provide a more comprehensive understanding of their growth trajectory and further refine growth curve models for this breed.

CONCLUSION

In conclusion, the birth type of Anatolian Merino lambs may have an effect on growth performance and daily live weight gain, while the gender effect on growth performance and daily live weight gain may become clearer in later ages. Additionally, due to the robust structure of Anatolian Merino lambs, despite being higher in single births, the similarity in survival rates according to birth types demonstrates that this productive breed also has high survival capabilities. Furthermore, linear regression models can be constructed for live weight, allowing for age prediction. Projects and support aimed at increasing the number of Anatolian Merino sheep can contribute to both livestock activities and economic benefits. Especially, raising awareness among rural communities in this regard, providing on-site employment, will promote both red meat and wool production as well as rural development.

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