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A study on the Determination of Some Reproductive Traits of Ewes and The Growth Performance of Lambs Akkaraman Raised under Farm Conditions in the Province of Niğde

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ABSTRACT

In this study, the reproductive and growth performance of Akkaraman sheep between 2017-2021 were evaluated within the scope of the National Sheep and Goat Breeding Project in the Hand of the Public, which is being carried out in the province of Nigde. In the research, data obtained from 30923 animals in 22 farms in 7 villages in the central district of Nigde province were used. In the study, the effect of year, dam's age, gender and birth type on birth weight (BW), live weight on day 60 (LW1), live weight on day 120 (LW2), daily live weight gain (DLWG) on day 120 were investigated. The effects of year, dam's age, gender and birth type on BW, LW1, LW2, DLWG were found to be statistically significant. While the effects of year, dam's age and gender were found to be statistically effective on SR, the effect of birth type was found to be insignificant. In the study, fertility, fecundity and litter size in Akkaraman lambs were determined as 0.92, 1.03 and 1.13, respectively. As a result, remarkable progress has been achieved in Akkaraman lambs in terms of performance characteristics (LW1, LW2 and DLWG) between 2017 and 2021.

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Introduction

Sheep transforms non-agricultural areas, fallow lands and pastures into milk, meat, and wool (Esen and Bozkurt, 2001; Yıldız and Denk, 2006). In this production line, while wool has lost its importance in Turkiye over the years, raw sheep milk no longer makes enough money for the producer. Therefore, farmers have turned to sheep and lamb meat production as their primary source of income (approximately 90%) (Demiral and İşcan, 2012). People should provide almost (about 42%) half of their daily protein needs from animal sources for a balanced and healthy diet. This situation reveals the importance of sheep and lamb meat from animal protein sources (Şahin et al., 2021; Sarı et al., 2022).

The 2021 Turkish Statistical Institute data shows 45,177,690 sheep in Turkiye, 91.1% of which are indigenous sheep breeds (TurkStat, 2021). The Akkaraman sheep, which is one of the indigenous breeds of sheep, account for 40 to 45 percent of the sheep population in Turkiye (Akçapınar, 2000; Esen and Özbey, 2000; Sakar and Ünal, 2021; Noyan and Ceyhan, 2021). The Akkaraman sheep breed also accounts for the majority of the total sheep population (614,809 head) in Nigde (Ceyhan et al., 2019; Noyan and Ceyhan, 2021).

While sheep and lambs have a share of 19.6% (385,933 tons) in Turkiye's total red meat production of 1,962,038 tons, cattle have a share of 74.4% (1,460,719 tons) (TurkStat, 2021). With the strategy of "profitable sheep breeding" and "high red meat production in parallel with rapid population growth," increasing animals' fertility and carcass weight, thus the proportion of sheep meat in red meat production is essential for solving the red meat problem in Turkiye (Tekerli et al., 2002; Türkyilmaz et al., 2021). The offspring produce of ewes can be evaluated according to "mating and lambing results" and "weaning

results" (Kaymakçı, 2016). High results of both offspring yield factors are critical to increasing breeders' incomes. Offspring production is also paramount in the preservation of flock and effective weeding and selection in herds (Yıldız and Denk, 2006).

In sheep breeding enterprises whose income stands on lamb meat production, the number of lambs at the weaning and marketing age and its continuity is one of the most crucial issues (Koyuncu and Duymaz, 2017). Therefore, lamb raising with less loss and high survivability is essential, as well as high progeny performance in sheep breeding. Vitality is an indicator of adaptation to environmental and regional conditions. Previous studies reported that many factors affect survival rate, such as birth weight (Morris et al., 2000; Koyuncu and Duymaz, 2017; Türkyilmaz et al., 2021), gender (Koyuncu and Duymaz, 2017; Güngör and Ünal, 2020), genotype (Özbey and Akcan, 2003; Mundan and Özbeyaz, 2004; Güngör and Ünal, 2020; Türkyilmaz et al., 2021), birth type (Ürüşan and Emsen, 2010; Yakan et al., 2012; Koyuncu and Duymaz, 2017) birth year (Aktaş et al., 2014; Oğrak, 2020), dam's live weight at birth (Aktaş et al., 2015), dam's nutrition (Koyuncu and Duymaz, 2017; Kutlu et al., 2022), dam's age (Morris et al., 2000; Sawalha et al., 2007; Koyuncu and Duymaz, 2017; Türkyilmaz et al., 2021), parity and ram effect (Morris et al., 2000; Aktaş et al., 2015).

It has been stated that birth weight, one of the developmental characteristics of Akkaraman lambs addressed in the study, is an indicator of fetal growth in lambs (Esen and Yıldız, 2000; Özbey and Akcan, 2003). The birth weight, which significantly determines the live weight at weaning and postweaning, can affect the future development of the lamb and the live weight of the fattened lambs, and thus the carcass productivity postweaning and butchery periods (Bozdepe et al., 1994; Karakuş, 2007).

It has been reported that while excessive birth weight can cause parturition difficulties, low birth weight can make lambs more susceptible to hypothermia, especially in cold regions. In addition, low birth weight in lambs may not only increase the risk of respiratory disease but may also reduce postnatal survivability for a number of reasons, including inadequate colostrum intake due to poor sucking reflex. For this reason, some studies argue that the lamb's birth weight should be 4-5 kg optimally (Akçapınar, 2000; İpek, 2012, Gaur et al., 2022).

While some previous studies report that lambs' genotypes affect birth weight (Odabaşıoğlu et al., 1996; Esen and Yıldız, 2000; Ürüşan and Emsen, 2010; Güngör and Ünal, 2020), some studies advocates the existence of other factors such as, dam's age (Esen and Yıldız, 2000; Ünal et al., 2006; Yakan et al., 2012; Aktaş et al., 2014; Güngör and Ünal, 2020), gender (Esen and Yıldız, 2000; Ünal et al., 2006; Yakan et al., 2012; Ceyhan et al., 2019; Güngör and Ünal, 2020; Behrem, 2021; Noyan and Ceyhan, 2021), birth type (Odabaşıoğlu et al., 1996; Esen and Yıldız, 2000; Ünal et al., 2006; Yakan et al., 2012; Aktaş et al., 2014; Ceyhan et al., 2019; Sakar and Erişek, 2019; Güngör and Ünal, 2020; Behrem, 2021; Noyan and Ceyhan, 2021; Türkmen and Çak, 2021), farm condions (Sakar and Erişek, 2019); birth season (Yakan et al., 2012; Aktaş et al., 2014; Ceyhan et al., 2019; Güngör and Ünal, 2020; Behrem, 2021; Noyan and Ceyhan, 2021), dam's live weight at birth (Şireli, 2019), dam's nutritional status (Esen and Yıldız, 2000; Dogan and Şahin, 2003; Şirin et al., 2017) and parity (Ürüşan and Emsen, 2010).

The high weaning weight improves the income of the farmer and the growth characteristics of the lambs after weaning (Boztepe et al., 1994). For this reason, researchers often focus on the live weight of lambs during the weaning period and their live-weight gains and growing up to this period. Numerous researchers have reported numerous factors such as year of birth, sex, birth weight, type of birth, season of birth, genotype, dam's age, body condition score of sheep at birth, adult body weight of sheep, and rearing methods that affect the developmental characteristics of lambs such as weaning live weight and live weight gain up to this period (Karakuş, 2007; Sarı et al., 2013; Bingöl and Bingöl, 2015; Güngör and Ünal, 2020).

The study, which is part of the Turkish National Sheep and Goat Breeding Project "Akkaraman Sheep Reared Rural Farm Conditions in Nigde Province" between 2017-2021, aims to determine the effect of some environmental factors on reproductive traits of ewes and growth and survival performance of lambs.

Material and Methods

The current study, examining the production records of 30923 heads of Akkaraman sheep between 2017-2021 in seven villages and 22 farms in Nigde, carried out studies in core and base flocks to increase the live weight of Akkaraman sheep. While the class-style mating was conducted in elite flocks (one adult ram to 30 sheep), free mating system was used in base herds (one adult ram to 20 sheep). In both methods, rams stayed in the flock for approximately 45 days between August 15 and September 30 each year. Following the lambing and the first colostrum intake of the lambs, their birth type, gender, birth weight, and date of birth, dam's age, and earring number data were recorded in the birth registration book to enter into their digital environments. Then, the lambs were registered with "lamb sign ear tag." The study, which started the birth recordings 145 days after the first ram participation in the herds, restricted the evaluation of the birth records to 60 days from the first birth.

In this study, the reproductive performance traits of Akkaraman ewes such as fertility (Formula 1), fecundity (Formula 2), litter size (Formula 3), fecundity at weaning (Formula 4) and litter size at weaning (Formula 5) were investigated as reported by Kaymakçı (2016).

$$F = \frac{EL}{EER} \quad (1)$$

$$FE = \frac{LB}{EER} \quad (2)$$

$$LS = \frac{LW}{EL} \quad (3)$$

$$FEW = \frac{LW}{ERR} \quad (4)$$

$$LSW = \frac{LW}{EK} \quad (5)$$

In the equations,
F = Fertility
EL = Number of ewes lambing
EER = Number of ewes exposed to the ram
FE = Fecundity
LB = Number of lambs born
LS = Litter size
FEW= Fecundity at weaning
LW = Number of lambs at weaning
LSW=Litter size at weaning

The survival rate of lambs was determined by the following equation according to the number of lambs living on the 120th day (Formula 6)

$$SR(\%) = \frac{NLW}{NLL} \times 100 \quad (6)$$

Where;

SR = Survival rate (%)
NLW= Number of lambs weighted on day 120
NLL = Number of live lambs born

In the study, 60-day live weight (LW1) and 120-day live weight (LW2) were determined according to year of birth, ewe age, method of birth and sex in the Elite and Base flocks, and live weight gain (DLWG) from birth to 120 days was calculated. LW1 and LW2 were adjusted according to formula 7 below, taking into account the age of the lambs.

$$Adjusted\ live\ weight = D - \left(b \times (E - G)\right) \quad (7)$$

In the equation,
D = Actual LW1 and LW2 weight (kg),
b = Partial regression coefficient between actual LW1 and LW2 weight and lamb age
E = Current lamb age (days)
G = Target lamb age (days) (60 days for LW1 and 120 days for LW2)

The following mathematical model was used for LW1, LW2, and DLWG.

$$Yijklm = \mu + a_i + b_j + c_k + d_l + e_{ijklm}$$

In this model;
Yijklm = Denotes LW1, LW2, and DLWG of m lambs in i birth season, w dam age, k gender, l birth type.
μ = Population mean
ai = Effect of the birth year (i= 5; 2017, 2018, 2019, 2020, and 2021)
bj = Effect of dam ages (j= 6; 2, 3, 4, 5, 6, and 7)
ck = Effect of gender (k=2; male and female)
dl = Effect of birth type (l=2; single and twin)
eijklm = Random error

In the current study, the effects of environmental factors on birth weight, LW1, LW2 and DLWG of Akkaraman lambs were determined using the least squares method in the general linear model (GLM) procedure. Duncan's multiple comparison test revealed the differences between the subgroup averages in the study (Düzgüneş et al., 1987), while the *z-test* revealed the differences between lambs' survivability, birth years, dam ages, genders, and birth types (P<0.05). The study employed IBM SPSS 23 (IBM Corp. Released, 2015) for data analyses.

Results

Growth Traits

Table 1 shows the least squares mean and standard errors of the live weights of Akkaraman lambs at birth and 60th day (LW1). In the study, the average birth weight of Akkaraman lambs was 4.36±0.01 kg. In the study, the lowest birth weight was found in 2017 (4.29±0.01 kg) and the highest in 2018 (4.50±0.01 kg) (P<0.01).

Table 1. Least squares means and standard errors (kg) of birth and 60th day live weights (LW1) in Akkaraman sheep

Traits	N	Birth Weight	N	LW1
Year		**		**
2017	6068	4.29±0.01d	5672	17.58±0.07d
2018	6309	4.50±0.01a	6057	20.22±0.06a
2019	6074	4.30±0.01cd	5754	16.98±0.07e
2020	6309	4.32±0.01c	6070	17.96±0.04c
2021	6163	4.39±0.01b	5796	19.42±0.05b
Dam's Age		**		**
2	4640	4.28±0.03c	4276	17.78±0.06a
3	4544	4.36±0.01ab	4325	18.70±0.07c
4	3756	4.38±0.01ab	3574	19.09±0.08a
5	2988	4.35±0.01b	2872	18.78±0.09b
6	4964	4.35±0.01b	4690	17.70±0.06c
7≥	10031	4.39±0.01a	9508	18.66±0.05b
Gender		**		**
Male	15129	4.44±0.01a	14290	19.02±0.03a
Female	15794	4.28±0.01b	14955	17.90±0.06b
Birth Type		**		**
Single	23914	4.51±0.06a	22686	18.71±0.04a
Twin	7009	3.82±0.06b	6559	17.55±0.04b
Overall	30923	4.36±0.01	29349	18.43±0.05

LW1: 60-day postnatal live weight; a, b, c, d: The differences observed between the averages shown in different letters in the same column are significant; **P<0.01

Table 2. Least square means and standard errors of 120th day live weight (LW2) and birth-120th day live weight gain (DLWG) in Akkaraman lambs

Traits	N	LW2 (kg)	DLWG (g)
Year		**	**
2017	5672	30.47±0.09 c	254±0.78d
2018	6033	34.95±0.08 a	291±0.69a
2019	5376	30.79±0.10 b	257±0.80c
2020	6070	30.45±0.08 c	254±0.64d
2021	5796	36.43±0.08 d	267±0.66b
Dam's Age		**	**
2	4325	31.86±0.10 c	257±0.68d
3	4294	33.08±0.10 b	266±0.71c
4	3536	33.87±0.12 a	273±0.94a
5	2832	33.03±0.13 b	269±1.04b
6	4657	31.03±0.10 d	255±0.79d
7≥	9303	33.06±0.07 b	269±0.60b
Gender		**	**
Male	14111	33.89±0.06a	275±0.50a
Female	14836	31.48±0.05b	255±0.41b
Birth Type		**	**
Single	22421	33.08±0.05a	268±0.37a
Twins	6526	31.18±0.09b	253±0.69b
Overall	28947	32.62±0.08	264±0.37

LW2: Live weight 120-day postpartum, DLWG: Daily live weight gain of lambs between birth and 120-day postpartum; a. b, c, d: The differences observed between the averages shown in different letters in the same column are significant.
**P<0.01

Table 3. Some progeny yield characteristics in Akkaraman sheep

Traits	2017	2018	2019	2020	2021	Overall
Fertility	0.90	0.92	0.94	0.93	0.91	0.92
Fecundity	1.01	1.05	1.01	1.05	1.03	1.03
Litter size	1.14	1.16	1.08	1.12	1.13	1.13
FEW	0.94	1.00	0.90	1.01	0.97	0.96
LSW	1.07	1.10	0.96	1.08	1.06	1.05

FEW: Fecundity at weaning; LSW: Litter size at weaning

The effects of year, maternal age, birth type and gender on birth weight were significant (P<0.01). In terms of LW1 weight, male lambs weighed 1.12 kg more than female lambs, while single lambs had 1.16 kg more live weight than the twin lambs. These differences were found to be statistically significant (P<0.01). When analyzing the LW1 weight of the lambs by years, the highest weight was recorded in 2018 (20.22±0.06 kg) and the lowest weight in 2019 (16.98±0.07 kg). The variation between lambing years was significant (P<0.01). While the LW1 of the lambs increased until the ewe was four years old, the LW1 values then decreased with the increasing age of the ewes.

In this study, least squares mean and standard errors for LW2 and DLWG are shown in Table 2. The study detected approximately 5.96 kg of total live weight gain between 2017 and 2021 in terms of LW2 (P<0.01). The highest LW2 values were in the lambs born in 2021 (36.43±0.08 kg), with a maternal age of 4 (33.87±0.12 kg), single-born (33.08±0.05 kg), and male (33.89±0.06 kg). The results of the study showed that the year, age of the dam, sex and type of birth had a significant effect on the DLWG value of the Akkaraman lambs (Table 2; P<0.01). The lowest DLWG was in the lambs born in the 2017 (254±0.78 g/lamb/day) and 2020 (254±0.64 g/lamb/day) years with a dam' age of six (255±0.79 g/lamb/day) (P<0.01). The study determined DLWG 275±0.50 and 255±0.41 g/lamb/day in male and female lambs and 268±0.37 and 253±0.69 g/lamb/day in single and twin lambs, respectively.

Reproductive performance and Lamb Survivability

Fertility, fecundity and litter size in Akkaraman ewes were 0.92, 1.03 and 1.13, respectively (Table 3).

The results for Akkaraman lamb survival at 120 days of age are presented in Table 4. Although the difference between birth types was not significant, the difference between sexes was significant (P<0.05) for SR in Akkaraman lambs. The highest survival rate was found in the year of the 2020 (96.21%), and the lowest was found in 2019 (88.50%) years (P<0.05).

Discussion and Conclusion

Growth Traits

Studies report that birth weight affects lamb survivability, and lamb size is a substantial risk factor for reduced lamb survival (Maud and Duffell, 1977). The study determined the birth weight value in Akkaraman lambs as 4.36 kg. In this research, the birth weight value determined for Akkaraman sheep was higher than the values determined by Odabaşıoğlu et al. (1996) (3.17 kg), Sakar and Ünal (2021) (3.87 kg), Ceyhan et al. (2019) (4.23 kg), Aktas et al. (2014) (4.05 kg), Behrem (2021) (4.19 kg), Dağ et al. (2000) (4.20 kg), Öztürk et al. (2018) (4.07 kg), and Noyan and Ceyhan (2021) (4.07 kg), but lower than the values determined by Çolakoğlu and Özbeyaz (1999) (4.91 kg), Akcapinar et al. (2000) (4.83 kg), Ünal (2002) (4.56 kg), Mundan and Özbeyaz (2004) (4.74 kg), Yakan et al. (2012) (4.50 kg).

Table 4. Means of survivability (SR) between birth and 120-day postpartum in Akkaraman lambs

Traits	NBL	NBL4	Survivability (%)[#]
Year		*	
2017	6068	5672	93.47b
2018	6309	6033	95.62a
2019	6074	5376	88.50c
2020	6309	6070	96.21a
2021	6163	5796	94.04b
Dam's age		*	
2	4640	4325	93.21bc
3	4544	4294	94.49a
4	3756	3536	94.14ab
5	2988	2832	94.77a
6	4964	4657	93.81ab
7≥	10031	9303	92.74c
Gender		*	
Male	15129	14111	93.27b
Female	15794	14836	93.93a
Birth Type		NS	
Single	23914	22421	93.75
Twins	7009	6526	93.10
Overall	30923	28947	93.60

NBL: The number of live-born lambs, NBL4= The number of lambs that survived to 120 days of age; #: The survivability of lambs was determined according to the data of the 120th day; *:P<0.05; NS: Nonsignificant

Different research findings from similar settings might be attributed to the differences in pregnancy care and feeding in farms and herds. The current study found the effects of gender, birth type, dam's age, and birth season as significant on Akkaraman's birth weight. Similar to the research findings, Aktaş et al. (2014) and Ceyhan et al. (2019) reported that the effects of gender, birth type, dam's age, and birth season were significant on birth weight in Akkaraman lambs. Contrary to the research findings, another study conducted on Akkaraman lambs found that the effect of gender on birth weight was insignificant. On the other hand, the same work found the impact of birth type as significant (Sakar and Erişek, 2019). Türkmen and Çak (2021), in their study on the same sheep breed in Van, found a significant effect of gender and birth type on the birth weight of lambs.

In the present study, the LW1 value determined for Akkaraman lambs (18.43 kg) was higher than the values reported by Odabaşıoğlu et al. (1996) (17.42 kg), Akçapınar et al. (2000) (17.63 kg), Kucuk and Eyduran (2009) (16.79 kg), Özmen et al. (2015) (17.27 kg), Türkmen and Çak (2021) (14.44 kg), but lower than the values reported by Şireli and Ertuğrul (2005) (21.30 kg), Yakan et al. (2012) (19.50 kg) Sakar and Erişek (2019) (22.11 kg). These different research findings might arise from the differences in growing conditions, care, feeding and herd breeding level. The study found the effect of birth year, gender, maternal age, and birth type o,n LW1 to be significant. Similar to this research finding, Sakar and Erişek (2019) reported a significant difference between singleton and twin Akkaraman lambs in LW1 but observed an insignificant difference between males and females. Reportedly, the effect of sex and birth type on LW1 was significant in these Akkaraman lambs raised in the Çaldıran district of Van.

In the current study, the LW2 value was 32.62 kg. LW2 value in Akkaraman lambs has varied between 28.40 and 31.7 kg in many previous studies (Akçapınar et al., 2000; Yakan et al., 2012; Aktaş et al., 2014; Özmen et al., 2015). In this study, the LW2 value determined for Akkaraman lambs was lower than the value reported by Sakar and Erişek (2019) (34.95 kg). The effects of birth year, gender, birth type, and dam's age on LW2 in Akkaraman lambs examined in the present study were significant. Two previous studies on the growth characteristics of Akkaraman lambs reported a significant effect of gender but an insignificant effect of dam's age on LW2 (Yakan et al., 2012; Aktaş et al., 2014). Similar to research findings, Yakan et al. (2012), Aktas et al. (2014), and Sakar and Erişek (2019) reported that the effect of birth type on LW2 was insignificant.

The DLWG found in this research was higher than the values documented by Odabaşıoğlu et al. (1996) (208 g/lamb/day) and Ceyhan et al. (2019) (226 g/lamb/day). These different research findings might arise from the lamb age and care-feeding differences. As part of the "Native Breeding Project" in Çankırı city, Sakar and Erişek (2019) determined the DLWG value as 254.4 g/lamb/day in Akkaraman male lambs, 255.7 g/lamb/day in female lambs, 255.5 g/lamb/day in singleton lambs and 252.9 g/lamb/day in twin lambs. The current study determined the DLWG value for Akkaraman lambs as similar to the value reported by Sakar and Erişek (2019) in female and twin lambs, higher than the values reported for males and singletons. Again, the same researchers found insignificant DLWG differences between males and females and singletons and twins.

Reproductive Performance

In the study, the fecundity value determined in Akkaraman sheep (1.03) was higher than the values reported by Esen and Özbey (2002), Odabaşıoğlu et al. (1996), Türkmen and Çak (2021) but similar to the values reported by Tekerli et al. (2002) (1.06 for the 1998-1999

birth season), Yakan et al. (2012) (1.02), Ceyhan et al. (2019) (1.01). This value in Akkaraman sheep was lower than those reported by Tekerli et al. (2002) (1.33 for the 1999-2000 birth season and 1.22 for the 2000-2001 birth season) and Özbey and Akcan (2000) (1.18).

The current study found the lowest fertility in 2017 (0.90) and the highest in 2019 (0.94) for Akkaraman sheep. In the study, the fertility of Akkaraman sheep was 0.92 over five years. This value was higher than the findings of numerous researchers (0.69-0.90) examining the progeny yield characteristics of the Akkaraman breed (Özbey and Akcan, 2000; Esen and Bozkurt, 2001; Esen and Özbey, 2002; Ünal et al., 2006; Yakan et al., 2012; Ceyhan et al., 2019; Güngör and Ünal, 2020; Türkmen and Çak, 2021). The fertility of Akkaraman sheep was reported by Akçapınar et al. (2000) as 0.93, by Özmen et al. (2015) as 0.94, and by Büyüktekin and Öztürk (2018) as 0.91. In the study, the fertility determined in Akkaraman sheep was similar to the values documented by Akçapınar et al. (2000) and Büyüktekin and Öztürk (2018), but lower than the value discovered by Özmen et al. (2015).

The litter size value for Akkaraman sheep was reported by Akçapınar et al. (2000) as 1.15 in 1996, by Özbey and Akcan (2000) as 1.39, by Esen and Bozkurt (2001) as 1.06 in the control group, by Esen and Özbey (2002) as 1.16, Tekerli et al. (2002) for the 1998-1999, 1999-2000, and 2000-2001 birth seasons as 1.33, 1.33, 1.31, respectively, by Ünal (2002) as 1.12, by Ünal et al. (2006) as (1.26), by Yıldız and Denk (2006) as 1.00, 1.00, 1.00, 1.02 for Van/Central, Van/Edremit, Van/Saray and Saray/Sırımlı, respectively, by Demiral and İşcan (2012) as 1.20 in the control group, by Yakan et al. (2012) as 1.19, by Özmen et al. (2015) as 1.15, by Büyüktekin and Öztürk (2018) as 1.35, by Ceyhan et al. (2019) as 1.12, by Güngor and Ünal (2020) as 1.27, by Oğrak (2020) as 1.22, by Türkmen and Çak (2021) as 1.03. In this research, the fertility per lambing Akkaraman sheep (1.13) was similar to the values announced by Akçapınar et al. (2000) in 1996, Esen and Özbey (2002), Özmen et al. (2015), Ceyhan et al. (2019). Different findings of research groups might arise from the differences in the birth year, care, feeding, breeding levels of the herds, and the conditions of the region where the sheep grows.

Lamb Survivability

Survivability is an indicator of adaptation to environmental conditions and can affect profitability in sheep farming (Koyuncu and Duymaz, 2017). The survivability in this research emerged between 88.50% (2019) and 96.21% (2020) over the years. The study found the survivability of Akkaraman lambs as 93.60% from birth to the 120th postnatal day. In the study, the Akkaraman breed SR value (96.21%) was higher than the value (90.06%) reported by Özmen et al. (2015) and lower than the value (97.00%) reported by Çolakoğlu and Özbeyaz (1999). The SR value of 96.21% observed in the study over the years might indicate that the Akkaraman sheep are well-adapted to the regional conditions. Previous studies on the Akkaraman sheep survival rate between birth and 90 days documented that the survival rate in lambs varied between 90.39% and 97.67% (Akçapınar et al., 2000; Ünal, 2002; Güngör and Ünal, 2020; Oğrak, 2020; Türkmen and Çak, 2021).

As a result, in terms of LW2, a live weight increase of 5.96 kg and a producer's income increase of 20% were achieved in Akkaraman sheep in five years between 2017-2021. The highest birth weight was in 2018. An enhancement of approximately 100 g in birth weight per lamb and 1% in herd survivability has been achieved from the day project started to the day it ended. The effect of environmental factors on all developmental characteristics of Akkaraman lambs was significant. In this research, the survival and growth characteristics such as LW1, LW2, and DLWG of Akkaraman lambs reared rural farm condions in Nigde province were similar to or higher than most literature reports. In the study, the litter size as a fertility characteristic was found to be partially lower than the value reported for Akkaraman in the literature.

It is predicted that a significant progress in the project will be achieved in development characteristics and fertility characteristics of the Akkaraman breed (especially litter size) in the next 5 years within the scope of National Sheep and Goat Breeding Project in the Hand of the Public in Nigde province by improving the breeding conditions.

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