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Kid growth performance and reproductive characteristics of Hair goats raised under breeder conditions

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Abstract: In the study, fertility parameters of Hair goats and the growth performance of kids raised under farmer conditions were investigated. The data of birth weight of 28,768 kids, the body weight of 27,541 kids aged d 90, and reproductive parameters of 26,693 does were used between 2013 and 2017 years. The birth weights of Hair goat kids born in 2013, 2014, 2015, 2016, and 2017 years were 2.36, 2.46, 2.56, 2.61, and 2.61 kg, whereas body weights detected on the d 90 were 15.2, 12.7, 12.8, 13.1, and 14.5 kg, respectively. Year, sex, birth type, and age of does affect significantly the birth and body weight of the kids on d 90 ($p < 0.01$). The survival rate detected on d 90 of kids was 100%, 98.7%, 94.5%, 93.9%, and 91.8% in 2013, 2014, 2015, 2016, and 2017 years, respectively. The effect of year on the viability of kids was found to be statistically significant ($p < 0.01$). Twinning rates of does were 3.5%, 5.7%, 9.5%, 12.4%, and 6.5%; kid yields per birth was 1.00, 1.00, 1.09, 1.12, and 1.00 in 2013, 2014, 2015, 2016, and 2017 years, respectively. The average birth rate was 91.9%, whereas the infertility rate was 8.1%. It was concluded that year, sex, and birth type influenced the kid growth performance of Hair goats due to variations in environmental factors such as management and feeding system. Therefore, if the management practices, nutrition, and health issues are improved, the growth performance of Hair goat kids and some reproductive parameters of Hair goats may be better.

Keywords: Hair goat, birth weight, growing performance, viability, the twinning rate

1. Introduction

Goat breeding plays an important role in the Turkish livestock sector due to utilising unfavourable lands in high capacity, adaptation, disease resistance, and also the increasing demand for goat products [1].

There are 12,341,514 goats in Turkey and about 97.7% of them are Hair goats [2]¹. In 2021, approximately, 622,785 tons of milk were produced from goats, and almost of all them have been produced from Hair goats [2]. On the other hand, 94,555 tons of meat are produced from the goat population. In Turkey, goats are corresponding to 2.7% of milk and 4.8% of meat production¹.

Loss of kids, one of the biggest problems of goat breeding, commonly occurs between partum and weaning [3]. Viability that is crucial for the profitability of goat farms describes the survival of kids until mature age [4]. It has been reported that factors such as birth weight, birth type

(single or twin), management, feeding, year and season of birth, breed, and sex of kids affect the survival rate of kids [5–7]. However, there have been other reports that genotype, sex, birth type, year, farm condition, and the age of the goat did not alter the survival rate of kids during the suckling period [8]. Oral and Altinel [9] reported that sex and the age of the dam are effective on the body weight of kids throughout 8 months of age, whereas the body weight of kids on 4th and 5th months of age is only altered by birth type and birth weight of kids. In addition, conditions such as male kids, singleton pregnancy, and does older than 4 years may cause higher kids birth weight.

Registered Notification of Domestic Animal Breed and Lines² declares that birth weight of Hair goat kids is 3.37 kg; body weight on d 60–90 is 11.36–18.7 kg; survival rate 94.0%–100% and kid yields per birth are 1.10. It has been stated that only the birth weight of kids is capable to alter

¹ TURKSTAT (2021). Turkish Statistical Institute Statistics. [online]. Website <http://www.turkstat.gov.tr/Start.do> [Accessed 11 May, 2022]

² Communiqué on the registration of domestic animal breeds and lines, Official Gazette, Number: 25668, Date: 12.12.2004. Website <https://www.resmigazete.gov.tr>. [Accessed 15 Dec, 2019]

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survival performance until 3 months old in goats housed in extensive conditions [9].

Fertility is one of the most indispensable conditions for maintainability and profitability in all animal production models. Therefore, it is essential to detect and monitor fertility parameters in flocks. In this study, it was investigated the birth weight, survival rate, and growth performance of kids, as well as some fertility parameters in Hair does housed under breeder conditions in a rural area.

2. Materials and methods

A total of 6288 Hair goats (5998 does and 290 bucks) housed on 30 farms located in 10 villages in Ulukışla county in Niğde province (Central Anatolia) was evaluated between 2013 and 2017 in this study. The data of birth weight of 28,768 kids, body weight of 27,541 kids aged at d 90, and some fertility parameters of 26,693 does were used.

Goats were mated first two weeks of September and November which is the mating season in the region. Bucks were separated for two months before the mating and they were fed by pasture feeding supplemented with 300 g/d barley grain, whereas does were fed by only pasture feeding. One buck was used per 25 does.

Kids were weighed by a digital scale to determine the birth weight in the first 24 h following partum and identified with ear tags. The data of ear tags, birth weight, birth date, birth type (single or twin), sex of kids and ear tags of the mother were recorded. Kids were allowed to suck colostrum and colostrum left in the udder was milked. Kids were kept together with their mothers for one week following partum then kids were separated and were allowed to suck three times per day during the first month, two times per day in the second month, and once a day in the third month. Kids were additionally pastured when they were not suckling. Kids were fed with dried alfalfa. The milk left in the udder was milked by hand until the weaning period. Kids were injected with selenium and vitamin E as well as antiparasitic medicine recommended by local veterinarians. Kids were weaned and weighed at approximately d 90 and they were pastured without any feed supplementation. During weaning, phenotype properties, presence of disease, lameness etc. were recorded and kids that were not suitable were recorded. All data including the date of the mating of bucks as well as parturition data was recorded in the logbooks on each farm, and then they were transferred to the computer.

Breeders were informed and notebooks were given to record the data related to the mating of bucks (number of ear tags of does and bucks, date of mating), pregnancy, parturition (birth weight, sex, birth type, and birth date etc.) and milking as well as mating procedures.

Fertility parameters were calculated by equations [10] as shown below:

Birth rate: (number of does giving birth/number of does suitable for mating) x 100

Infertility rate: (number of does not giving birth/number of does suitable for mating) x 100

Single kidding rate: (number of does giving single-born kids/number of does giving birth) x 100

Twinning rate: (number of does giving twin-born kids/number of does giving birth) x 100

Kid yields per birth: (number of kids born/number of does giving birth)

Kid yields per doe: (number of kids born/number of does suitable for mating)

Viability on d 90: (number of weaned kids/number of kids born) x 100

Data were organized in spreadsheets (Excel 2013; Microsoft, Redmond, WA), and all subsequent analyses were performed using SAS [11]. The growing performance of kids was analysed using the general linear model. The statistical model was as follows:

$$Y_{ijklmn} = \mu + \alpha_i + \beta_j + \gamma_k + z_l + (z\gamma)_m + e_{ijklmn}$$

Y_{ijklmn} = the dependent variable

μ = population mean

α_i = i. effect of doe age, i=1, 2, 3 (2, 3, 4 \geq)

β_j = j. effect of birth type, j= 1, 2 (single, twinning)

γ_k = k. effect of sex, k=1, 2 (male, female)

z_l =l. effect of year, l=1, 2, 3, 4, 5 (2013, 2014, 2015, 2016, 2017)

$(z\gamma)_m$ = m. effect of the year by sex interaction

e_{ijklmn} = residual

Interaction between factors was determined by preanalysis and significant ones were added to the model [12]. The significance of differences between averages of groups was determined by the Duncan multiple comparison test. The survival rate of kids was tested by chi-square analysis in SAS [11]. The least-square means and related standard error were used in tables.

3. Results

Kidding occurred between February and March. It was found that the effect of year, sex, birth type and age of does on birth weight and body weight on d 90 for kids was statistically significant ($p < 0.01$, Table 1).

It was detected that the effect of year and sex as well as year x sex interaction on body weight of male and female breeding goats on d 90 was statistically significant ($p < 0.01$, Table 2).

It was determined that survival rate of kids on d 90 was 100%, 98.7%, 94.5%, 93.9%, and 91.8% at 2013, 2014, 2015, 2016, and 2017, respectively (Table 3). Moreover, the year effect affected the survival rate of kids on d 90 ($p < 0.01$). There was no significant difference but the survival rate of kids was higher in male (95.97%) and single kids (95.79%) than those detected in females (95.47%) and

Table 1. Effects of year, sex, birth type, and age of does on birth weight, and body weight on d 90 of Hair goat kids.

Items	Birth weight (kg)		Body weight on d 90 (kg)	
	n	LSM ± SE	n	LSM ± SE
Overall	28,768	2.52 ± 0.011	27,541	13.68 ± 0.038
Birth year				
2013	5450	2.36 ± 0.015d	5450	15.20 ± 0.055a
2014	5662	2.46 ± 0.015c	5589	12.73 ± 0.054d
2015	6170	2.56 ± 0.014b	5828	12.82 ± 0.050d
2016	6100	2.61 ± 0.013ab	5730	13.10 ± 0.046c
2017	5386	2.61 ± 0.011a	4944	14.51 ± 0.041b
p	**		**	
Sex				
Female	13,952	2.48 ± 0.011	13,321	13.46 ± 0.041
Male	14,816	2.56 ± 0.011	14,220	13.89 ± 0.041
p	**		**	
Birth type				
Twin	4151	2.33 ± 0.014	3958	13.60 ± 0.051
Single	24,617	2.71 ± 0.010	23,583	13.76 ± 0.036
p	**		**	
Age of does				
2	592	2.57 ± 0.006ab	543	13.30 ± 0.112b
3	2134	2.47 ± 0.031b	1955	13.57 ± 0.061a
≥4	3512	2.53 ± 0.013a	3260	13.87 ± 0.048a
p	**		**	

a,b,c,d: Letters within the same column denote significant difference between means ($p < 0.01$)

** $p < 0.01$: significant.

twin kids (95.35%). The kids born from does that were 2, 3, and 4 years old had 91.72%, 91.61%, and 92.82% survival rates, respectively.

Over the five years (2013, 2014, 2015, 2016, and 2017), the kidding rate was 91.9%, while the infertility rate was 8.1%. It was determined that the twinning rates were 3.5%, 5.7%, 9.5%, 12.4%, and 6.5% in 2013, 2014, 2015, 2016, and 2017, respectively, and that the average twinning rate was 7.5%. The number of kid yields per birth in 2013, 2014, 2015, 2016, and 2017 was 1.00, 1.00, 1.09, 1.12, and 1.00 respectively and the average kid yields per birth were 1.04 (Table 4).

4. Discussion

In this study, it was determined that the overall birth weight of goat kids studied was 2.52 kg. This value was lower than those detected by Tekin and Ögeç [13] (3.07

kg in male kids, 2.96 kg in female kids; overall 3.02 kg), Atay and Gökdal [14] (3.1 kg), Registered Notification of Domestic Animal Breed and Lines² (3.37 kg), Tatar et al. [15] (3.17 kg), Elmaz et. [16] (3.26–3.41 kg), and Tekin and Arlı [17] (3.55 kg in male kids, 3.40 kg in female kids; overall 3.48 kg), whereas it was similar to the results (2.58 kg) that were reported by Oral and Altınel [9]. Oral and Altınel [18] performed on hair goats housed in extensive conditions, it has been reported that birth weight was 2.19 kg. Furthermore, it was reported that the birth weight of kids was 3.7 kg and 2.6 kg in Saanen x Hair goat crossbreeds and pure hair goats, respectively [19]. Şimşek and Bayraktar [20] stated that F_1 hybrids (Hair goats and crossbreeds of Saanen x Hair goat) had 2.77 kg and 2.95 kg, respectively. Şimşek et al. [21] found that crossbreeds of Saanen x Hair goats (F_1) and Saanen x Hair goats (G_1) showed 2.18 kg and 2.82 kg, respectively, whereas Gül et al.

Table 2. Effects of year and sex on d 90 of body weight of kids selected as stock breeding.

Item		Body weight on d 90		
		n	LSM ± SE	P
Overall		5287	16.27 ± 0.038	
Birth year				**
2013		931	16.38 ± 0.079 ^b	
2014		966	15.00 ± 0.078 ^c	
2015		1086	15.96 ± 0.075 ^c	
2016		1127	16.46 ± 0.071 ^b	
2017		1177	17.57 ± 0.070 ^a	
Sex				**
Female		4022	15.66 ± 0.037	
Male		1265	16.89 ± 0.066	
Sex x Year				**
Female	2013	733	16.03 ± 0.085	
	2014	741	14.17 ± 0.085	
	2015	908	15.32 ± 0.077	
	2016	808	15.71 ± 0.081	
	2017	832	17.06 ± 0.080	
Male	2013	198	16.01 ± 0.164	
	2014	225	16.32 ± 0.154	
	2015	178	16.69 ± 0.173	
	2016	319	17.40 ± 0.129	
	2017	345	17.94 ± 0.124	

a,b,c: Letters within the same column denote significant difference between means ($p < 0.01$)

** $p < 0.01$: significant.

[22] indicated 2.6 kg, 3.2 kg, and 3.2 kg in crossbreeds of Hatay goats, German Fawn goats x Hair goats and Saanen x Kilis goats, respectively and it was 3.1 kg for Toros Alaca goats [23]. It is suggested that those differences might be related to phenotype and genotype properties of Hair goats breeding in different locations of the country as well as breeding conditions. However, this study showed that the effect of year, sex, birth type and age of does on the birth weight of kids were significant and this was consistent with Şengonca et al. [19] who reported that type of flock and parturition, as well as the year, were effective on birth weight of kids.

In this study, it was determined that the average body weight of kids on d 90 was 13.68 kg, whereas the average body weight of kids selected for a breeding goat on d 90 was 16.27 kg. Those values detected in this study were similar (11.36–18.7 kg) to Registered Notification of Domestic

Animal Breed and Lines² and Oral and Altinel [18] (13.58 kg) and lower than those determined by Atay and Gökdal [14] (19.1 kg), Tatar et al. [15] (20.1 kg), and Elmaz et al. [16] (18.5 kg in male kids, 16.6 kg in female kids). On the other hand, crossbreeding studies showed that the average weaning weight was 14.68 kg and 12.12 kg in Saanen × Hair goat and pure breed Hair goats, respectively [18].

Şimşek and Bayraktar [20] reported that the weaning body weight was 16.05 and 14.14 kg in Hair goat and Saanen × Hair goat (F_1), respectively, whereas Saanen x Hair goat (F_1) and Saanen × Hair goat (G_1) had 14.1 kg and 15.6 kg, respectively [22]. Ceyhan [23] reported that Toros Alaca goats had 21.6 kg on d 90. The values of body weight of kids on d 90 were found to be similar to some reports, whereas there were discrepancies with some other studies. It is suggested that those differences might be related to genotype properties or environmental factors such as year, farm, and duration of suckling. In this study, it was found that year, sex, birth type, and age of does were effective on the body weight of kids on d 90. Similarly, year and interaction of year × sex were effective on body weight on d 90 of male and female kids selected for breeding. It was reported that the size of the flock was effective on the body weight of kids during weaning [19]. However, birth type, sex, and year [13], as well as age of does were also effective factors on body weight [13, 19]. Şimşek and Bayraktar [20] stated that sex and birth type altered the body weight gain during the suckling period (0–90 days), while age of does was not effective on this parameter.

In this study, it was determined that the survival rate on d 90 of kids in 2013, 2014, 2015, 2016, and 2017 was 100%, 98.7%, 94.5%, 93.9%, and 91.8% respectively, whereas the overall survival rate was 95.7%. Those results obtained in this study were consistent with the value of Registered Notification of Domestic Animal Breed and Lines² in which the viability rate was 94.0%–100% until weaning and Elmaz et. [16] found that 96.44%, 92.70%, 94.06%, 94.31%, and 97.02% in 2012, 2013, 2014, 2015, and 2016, respectively and the differences between the years in terms of survival were statistically significant ($p < 0.05$). However, Tekin and Ögeç [13] and Tekin and Aralı [17] reported that the survival rate of kids was 80.7% and 89.23% which were lower than that detected in the study. It was reported that the survival rate of pure breeds such as Hair goat, Saanen, Toros, and Hatay goats was between 78.6%–92.0% [8, 19–23]. It was shown that crossbreeding of Saanen goats with Hair goats increased the survival rate of kids [8, 19, 21]. In this study, the higher overall survival rate (95.7%) suggested that the management of farms might be an effective factor to increase the economic viability of goat husbandry.

It was found that the year was effective on the viability of kids on d 90. It has been reported that flock and year

Table 3. The survival rate of kids on d 90.

Years	2013	2014	2015	2016	2017	Overall	p
Number of kids born alive	5450	5662	6170	6100	5386	28768	
Number of kids live at d 90	5450	5589	5828	5730	4944	27541	
The survival rate on d 90 (%)	100.0a	98.7b	94.5c	93.9c	91.8d	95.7	**

a,b,c,d: Letters within the same column denote significant difference between means ($p < 0.01$)

** $p < 0.01$: significant.

Table 4. Some reproductive characteristics of Hair goats

Reproductive characteristics	2013	2014	2015	2016	2017	Overall
Number of does suitable for mating	5998	5998	6000	6000	6000	29,996
Number of does giving birth	5450	5662	5638	5427	5386	27,563
Number of does not giving birth	548	336	362	573	614	2433
Kidding rate, %	90.9	94.4	94.0	90.5	89.8	91.9
Infertility rate, %	9.1	5.6	6.0	9.6	10.2	8.1
Number of does giving single-born kid	5258	5336	5105	4753	5035	25,487
Number of does giving twin-born kid	192	327	533	674	351	2077
Single kidding rate, %	96.5	94.2	90.5	87.6	93.5	92.5
Twinning rate, %	3.5	5.7	9.5	12.4	6.5	7.5
Number of kids born alive	5450	5662	6170	6100	5386	28,768
Kid yields per does	0.91	0.94	1.03	1.02	0.90	0.96
Kid yields per birth	1.00	1.00	1.09	1.12	1.00	1.04

were effective on the survival rate of kids [19]. However, birth type, sex, and genotype were stated as noneffective factors for the survival rate [8, 20, 21]. The study similarly showed that the year affected the survival rate. Therefore, it is suggested that environmental factors related to the year may affect the survival rate of kids.

The study revealed that the overall kidding rate obtained from five-year (2013, 2014, 2015, 2016, and 2017) data was 91.9%, whereas the infertility rate was 8.1% in Hair goats. The twinning rates were 3.5%, 5.7%, 9.5%, 12.4%, and 6.5% in 2013, 2014, 2015, 2016, and 2017, respectively. Those values detected in this study were similar twin birth rate was 5.1% in general, it was 6.2%, 5.9%, 6.4%, 3.8%, and 3.1% in 2012, 2013, 2014, 2015, and 2016, respectively. The litter size was 1.05 on average to Elmaz et al. [16]. The overall twinning rate was 7.5%. Erten and Yilmaz [24] reported that kidding rates and twinning rates were 85.9% and 17.9%, respectively; whereas average kid yields per birth were 1.18 and the kidding rate was 101.3%. In this study, the overall kid yield per birth was 1.04, whereas the kid yields per birth were 1.00, 1.00, 1.09, 1.12, and 1.00 in 2013, 2014, 2015, 2016, and 2017, respectively. Erten and Yilmaz [24] showed higher rates

than those detected in the study. The difference might be related to the different management and farm factors stated in the reports. Registered Notification of Domestic Animal Breed and Lines reported² that the kid yields per birth of hair goat were 1.10. However, there have been such studies that the kid yields per birth are between 0.79 [19] and 1.26 [25]. In addition to this, it was shown that the kid yields per birth might be increased to 1.41 by different synchronisation protocols [26]. Therefore, it is suggested that management and fertility programs may be effective on kid profitability.

Şengonca et al. [19] compared Saanen x Hair goats and pure Hair goats and reported that the number of does, kid yields per does, kid yields per birth, and infertility rates were 1.25 and 0.72, 1.30 and 0.79, and 4.47% and 21.0%, respectively. It was determined that flock, year, and maternal age were important factors in the aforementioned parameters. In the flocks, Saanen x Hair goat and pure Hair goat, the twinning rate was determined as 89.9% and 72.7%, respectively. And, also, the flock, year, and maternal age were reported as important factors in the birth type.

Overall, it was found that the data on fertility, viability, and growing performance obtained in Hair goats housed

in rural extensive conditions showed similarities with other references. However, it is believed that the number of samples and duration of this experiment are able to give comprehensive results for livestock science. It is concluded that year, sex, and birth type influenced the kid growth performance of Hair goats due to variations in environmental factors such as management, climatical conditions, feeding system etc. Therefore, if the management practices, nutrition, and health issues are improved, the growth performance of Hair goat kids and some reproductive parameters of the goats may be better.

Conflict of interest

The authors declare that they have no conflict of interest.

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