Research Article

Reproductive performance and kid growth until weaning in Hair goat reared on-farm conditions in Turkey

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Abstract: This study was conducted to determine the growth traits, survival rates, and some reproductive traits of Hair kids reared on-farm in Antalya province of Turkey. The data concerning the birth weights of totally 22,817 kids and the 90th day live weights of totally 21643 kids were taken for a 5-year period within the scope of this study. In 37 flocks, the mean birth weights of the kids born in 2012, 2013, 2014, 2015, and 2016 were determined as 3.38, 3.41, 3.26, 3.32, and 3.26 kg, and also the mean live weights of 90th day (weaning) were found as 16.96 kg, 18.33 kg, 17.43 kg, 17.47 kg, and 17.53 by the years, respectively. The differences between the birth year, sex, type of birth, and the dam's age groups were statistically significant in terms of birth weight and 90th day live weight (P < 0.05). The survival rates of the kids on the 90th day were 96.44%, 92.70%, 94.06%, 94.31%, and 97.02% by the years (P < 0.05). In the study, the twin birth rate was 5.1% in general. It was revealed based on five-year data that Hair goats had adaptation to the region and breeding system with their survival rate exceeding 90%.

Key words: Hair goat, birth weights, survival rates, on-farm

1. Introduction

Indigenous goat breeds are animals which are well-adapted to the conditions of the region where they are reared [1]. Depending on the decreases in plant production made for food and feed purposes, it is suggested that the extensive production based on native breeds should not be completely abandoned. The indigenous breeds as genetic resources should be considered as an insurance of animal breeding. Recent studies have strongly confirmed that products obtained from indigenous breeds are healthier and have unique taste and quality traits, and they have revealed that products of indigenous breeds are demanded more in some countries [2,3].

Majority (97%) of goat reared in Turkey are Hair goats [4]. When considering its climate conditions, as well as abundance of natural pasture areas in high and mountainous lands, forest grasslands, and scrub-maquis shrubland, one of the most suitable regions for Hair goat breeding is the Mediterranean Region located in Turkey [5]. It has been reported that while birth weight of Hair goat kids were 2.19–3.17 kg, weaning weight varied between 12.12–20.01 kg [6–11]. While the number of kids

per mated doe is 0.72, the number of kids per birth and doe is 0.79 [7]. The studies on Hair goats have reported that survival rates until weaning (90th day) were between 82.50% and 95.44% [6–8,11,12]. However, another study gives the numbers of kids per birth and doe as 1.16 in 2–3-year-old and 1.26 in 4-5-year-old does. In the same study, the kidding rate for both age groups was 80% [13].

Viability and growth of kids are important determinants for productivity in goat breeding [14]. One of the key factors that negatively affects goat farmers in tropical and subtropical regions is the kid mortality. Birth weight is a major cause for kids to grow, develop, and also have a specific weight at a certain age as well as postnatal loss of kids [15]. Growth is among the physiological traits having an economic importance in animal breeding. As in all livestock, animal losses are among the major problems in goat breeding. Survival is the ability to survive until certain ages.

Hair goats are most commonly reared in Turkey; however, there is limited information about growth and viability of this goat breed. This study was conducted to determine the growth traits, survival rates and some

reproductive traits of Hair goat under on-farm conditions in Antalya province of Turkey by examining the effects of birth year and dam's age through a large set of data (for 5 years).

2. Materials and methods

2.1. Study area, animals, and data collection

This study is one of the steps of a project by General Directorate of Agricultural Research and Policies (GDARP) of the Ministry of Agriculture and Forestry, that has been carried out nationwide in order to preserve and improve the indigenous breeds and reveal their actual production traits. In the study, the data of the first 5 years (2011–2016) within the scope of the "Project of the improvement of Hair goat in on-farm in Antalya" within "National Sheep and Goat Breeding Project of Turkey" were used. In 2011, the study started with 6300 animals from 37 breeders in 20 villages in 5 districts of Antalya province.

According to its geographical conditions, the project province is divided climatologically into 2 parts (coastal and upland). Thus, mating periods take place between 15 August and 15 October in coastal areas and between 15 September and 15 November in upland areas. In order to determine the growth traits, birth weight and weaning (90th day) weights of the kids were determined. A statistical model with the fixed effects (birth year, sex, birth type, and dam's age) was used for determining the least square means of the weight traits. The data concerning the birth weights of totally 22,817 kids and the 90th day live weights of totally 21,643 kids were taken for a 5-year period within the scope of the study. The flocks were grazed and browsed in open range fields, maquis shrubland, and grassland in or around forests from early morning hours until noon. In general, this location has low amount and quality of grass. The numbers of the born kids and the numbers of kids reaching the weaning age were determined for calculating the survival rates of the kids. The traits such as number of kidding does per year, the number of single kidding goats, the number of twin kidding goats, and the litter size in every flock were taken in order to determine the reproductive traits.

2.2. Statistical analysis

The data were statistically compared by using 16.1 version of Minitab [16] statistical software package. A statistical model with the fixed effects (birth year, sex, birth type, and dam's age) was used for determining the least square means of the weight traits. The effects of birth year, dam age, sex, and birth type with their interactions on growth performance were analysed by using generalized linear model (GLM) procedure with birth weight as a linear covariate. When the dual interactions between the groups were examined, any statistically significant interactions were not exist (P values were ranging between 0.08 and 0.25)

between any of examined factors. Therefore, the statistical model was rerun after withdrawing the interactions and used model was determined. Tukey analysis was used to control for significance of differences between subgroups (P < 0.05). A descriptive statistical analysis was applied on the data related to reproduction characters. Chi-square test was used for statistical evaluation of the data in order to compare survival rates of kids for different examination periods (2012–2016).

3. Results

Table 1 shows the means of least squares (LS) according to the year of birth, sex, birth type, and dam's age of the birth weight and weaning (90th day) weight, examined as the growth traits of Hair goat kids.

In the study, it was determined that the LS mean of birth weights of the kids born in 37 flocks in 2012, 2013, 2014, 2015, and 2016 were 3.38, 3.41, 3.26, 3.32, and 3.26 kg, respectively. The LS mean birth weight was 3.52 kg in male goats and 3.13 kg in female goats. The LS mean birth weights of single and twin kids were 3.44 kg and 3.21 kg, respectively. Birth weights in the dam's age groups (2, 3, 4, 5, and 6 years) were determined as 3.14, 3.24, 3.56, 3.43, and 3.45 kg, respectively. The differences between the birth year, sex, type of birth, and the dam's age groups were statistically significant in terms of birth weight (P < 0.05).

It was found that LS mean live weights of weaning period (90th day) were 16.96 kg, 18.33 kg, 17.43 kg, 17.47 kg, and 17.53 kg by the years (2012, 2013, 2014, 2015, and 2016), respectively. In male and female kids, the LS mean live weights of 90th day were 18.50 kg and 16.59 kg, respectively. According to the type of birth, the mean live weights of 90th day were 17.63 kg and 17.46 kg in single and twin kids, respectively. The 90th-day LS mean live weights were 17.29 kg, 17.31 kg, 17.58 kg, 17.72 kg, and 17.82 kg, respectively for the kids of 2, 3, 4, 5, and 6-year-old dams. The differences among the birth year, sex, and the dam's age groups were statistically significant in terms of the 90th day live weight (P < 0.05).

In the project, the selection was made on the basis of the systematic factor of the corrected 90th day weights of the kids. Table 2 shows the 90th day LS mean live weights of the male kids selected for breeding and Table 3 shows the 90th day mean live weights of the female kids selected as breeding.

It was found that the LS mean live weights of 90th day were respectively 19.85, 21.15, 19.69, 20.47, and 20.99 kg in breeding male kids and 16.42, 17.23, 17.06, 17.17, and 17.12 kg in breeding female kids for the years 2012, 2013, 2014, 2015, and 2016. The differences between the birth year groups of breeding male and female kids were statistically significant in terms of weaning (90th day) live weight (P < 0.05).

Table 1. LS means and standard errors of birth and age of 90th day live weights by birth year, sex, birth type, and dam age (kg)

Factors	Birth weight		Day 90	
	n	LSM±SE	n	LSM±SE
Birth year				
2012	4916	3.38 ± 0.01^a	4741	16.96 ± 0.06^c
2013	4839	3.41 ± 0.01^a	4486	18.33 ± 0.06^a
2014	4902	3.26 ± 0.01^c	4610	17.43 ± 0.06^b
2015	4065	3.32 ± 0.01^b	3833	17.47 ± 0.07^b
2016	4095	3.26 ± 0.01^c	3973	17.53 ± 0.07^b
P	0.01		0.01	
Sex				
Male	11877	3.52 ± 0.01^a	11310	18.50 ± 0.05^a
Female	10940	3.13 ± 0.01^b	10333	16.59 ± 0.05^b
P	0.01		0.01	
Birth type				
Single	20579	3.44 ± 0.01^a	20023	17.63 ± 0.02
Twin	2238	3.21 ± 0.01^b	1620	17.46 ± 0.08
P	0.01		NS	
Dam's age (years)				
2	3231	3.14 ± 0.01^d	3111	17.29 ± 0.07^c
3	4187	3.24 ± 0.01^c	4026	17.31 ± 0.07^c
4	5133	3.56 ± 0.01^b	4863	17.58 ± 0.06^b
5	5091	3.43 ± 0.01^a	4810	17.72 ± 0.06^{ab}
6	5175	3.45 ± 0.01^a	4833	17.82 ± 0.06^a
P	0.01		0.01	

[a, b, c, d]: Means for each factor in the same column with different superscripts differ significantly (P < 0.05).
LSM: Least square means, SE: standard error, NS: Nonsignificant (P > 0.05)

According to the birth type, the 90th day LS mean live weights were specified as 20.44 kg and 20.42 kg, respectively in breeding male kids and 17.02 kg and 17.18 kg, respectively in breeding female kids among single and twin births. The effect of birth type on the 90th day live weight was not statistically significant in both male and female kids.

According to the dam's age groups (2, 3, 4, 5, and 6 years), the 90th day LS mean live weights were 21.12, 19.69, 20.28, 20.56, and 20.50 kg in breeding male kids and 17.19, 16.71, 17.14, 17.20, and 17.25 kg in breeding female kids, respectively. The effect of dam's age on the 90th day live weight was statistically significant only in breeding female kids (P < 0.05).

Table 4 shows the survival rates of the kids in the examined flocks until the 90th day by the years. The survival rates from the birth of the kids to the weaning were calculated. It was determined that the survival rates of the kids on the 90th day were 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).

Table 5 shows single birth rate, twin birth rate, and the litter size in terms of the years. While the 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.

4. Discussion
It was found in this study that the birth weight examined as a growth trait was 3.52 in male kids and 3.13 kg in female kids. These values of male and female hair goat

Table 2. Least square means and standard errors of birth and age of 90th day live weights for selected male kids by birth year, sex, birth type, and dam age (kg)

Factors	90th day weight of the male kids	
	n	LSM±SE
Birth year		
2012	242	19.85 ± 0.44 [bc]
2013	229	21.15 ± 0.45 [a]
2014	223	19.69 ± 0.46 [c]
2015	225	20.47 ± 0.47 [abc]
2016	177	20.99 ± 0.49 [ab]
P	0.01	
Birth type		
Single	1055	20.44± 0.16
Twin	41	20.42± 0.70
P	NS	
Dam's age (years)		
2	69	21.12 ± 0.66
3	136	19.69 ± 0.50
4	227	20.28 ± 0.44
5	354	20.56 ± 0.41
6	310	20.50 ± 0.40
P	NS	

[a, b, c]: Means for each factor in the same column with different superscripts differ significantly (P < 0.05).
LSM: Least square means, SE: standard error, NS: Nonsignificant (P > 0.05)

Table 3. Least square means and standard errors of birth and age of 90th day live weights for selected female kids by birth year, sex, birth type, and dam age (kg)

Factors	90th day weight of the female kids	
	n	LSM±SE
Birth year		
2012	1367	16.42 ± 0.14[c]
2013	1491	17.23 ± 0.13[a]
2014	1320	17.06 ± 0.14[b]
2015	1051	17.17 ± 0.15[b]
2016	1062	17.12 ± 0.15[b]
P	0.01	
Birth type		
Single	6080	17.02 ± 0.04
Twin	211	17.18 ± 0.23
P	NS	
Dam's age (years)		
2	488	17.19 ± 0.18[ab]
3	1007	16.71 ± 0.15[b]
4	1610	17.14 ± 0.14[ab]
5	1663	17.20 ± 0.13[a]
6	1523	17.25 ± 0.14[a]
P	0.01	

[a, b, c]: Means for each factor in the same column with different superscripts differ significantly (P < 0.05).
LSM: Least square means, SE: standard error, NS: Nonsignificant (P > 0.05)

kids were higher than 3.4 kg in male kids and 2.5 kg in female kids reported for Hair goats in "Domestic Animal Catalogue" [2]. These values were also higher than 2.46 kg for males and 1.92 kg for females reported by Oral Toplu and Altınel [6], 2.63 kg reported by Şengonca et al. [7], 2.77 kg reported by Şimşek and Bayraktar [8], averagely 3.17 kg reported by Tatar et al. [10], and 3.01 kg reported by Erten and Yılmaz [11], 2.58 kg reported by Oral and Altınel [12] for Turkish Hair goats. Additionally, the values determined in the present study were higher than 2.95 kg reported by Şimşek and Bayraktar [8] for Saanen × Hair goat crossbred F_1 kids and 2.18 and 2.82 kg reported by Şimşek et al. [17] for Saanen × Hair Goat F_1 and Saanen × Hair Goat G_1 crossbred kids, respectively. The birth weight values found in the present study were higher than those (2.6 kg, 3.2 kg, and 3.2 kg) specified for Hatay goat, German Fawn goat × Hair Goat, and Saanen × Kilis goat crossbred kids, respectively [18].

The birth weight was found to be 3.44 kg and 3.21 kg in single and twin kids, respectively. This result is compatible with the result of the study by Oral Toplu and Altınel [6] indicating that the birth weight was higher in single births (2.60 kg) compared to twin births (1.78 kg). In their studies, the researchers reported that kids of the 4-year-old dams had the highest birth weight and birth weight of the kids of 2-year-old dams increased until the age of 4. This result found by the researchers based on the dam's age is compatible with the results of the present study. Hence, the present study revealed that the lowest birth weight was obtained from 2-year-old dams (3.14 kg), the birth weight showed an increasing trend until the age of 4 years, and the highest birth weight was determined in 4-year-old dams (3.56 kg).

The effects of the birth year, sex, type of birth, and dam's age on birth weight were found to be statistically significant in the present study (P < 0.05). This result is

Table 4. Survival rates of the kids until the age of 90th day.

Years	2012	2013	2014	2015	2016	P
Number of born kids	4916	4839	4902	4065	4095	
Number of 90-day-old kids	4741	4486	4611	3834	3973	
Survival rates (%)	96.44[a]	92.70[c]	94.06[b]	94.31[b]	97.02[a]	0.01

[a, b, c]: Mean values of the factors in the same line with different superscripts differ significantly (P < 0.05).

Table 5. Some reproductive characteristics of Hair goat.

Years	Number of kidding does	Number of goats with single kid	Single birth rate (%)	Number of goats with twin kids	Twining rate (%)	Number of born kids	Litter size
2012	4628	4340	93.8	288	6.2	4916	1.06
2013	4571	4303	94.1	268	5.9	4839	1.05
2014	4609	4316	93.6	293	6.4	4902	1.06
2015	3917	3769	96.2	148	3.8	4065	1.04
2016	3973	3851	96.9	122	3.1	4095	1.03
Overall	21698	20579	94.9	1119	5.1	22817	1.05

compatible with results of several studies reporting that the effect of the birth year [7], sex [6,19], type of birth [6,7,17,19], and dam's age [6,17,19,20] on birth weight in kids are statistically significant (P < 0.05).

Another trait of growth performance examined in the study was the weaning (90th day) weight. It was found that this trait was higher in males (18.50 kg) than females (16.59 kg) and in single kids (17.63 kg) than twins (17.46 kg). The lowest 90th day weight, obtained in the kids of 2-year-old dams, increased with increasing age of the dam and thus the highest 90th day weight was determined in the kids of 6-year-old dams. The 90 th day weight obtained in the present study was higher than 13.08 kg [6], 12.12 kg [7], 16.05 kg [8], and 13.58 kg [12] for Turkish Hair goats as well as 14.68 kg reported by Şengonca et al. [7], 14.14 kg reported by Şimşek and Bayraktar [8], 12.41 kg for males and 12.23 kg for females reported by Erten and Yılmaz [11], 14.07 and 15.62 kg reported by Şimşek et al. [17] for Saanen × Hair goat crossbred kids, and 14.13 kg for Saanen goats, and 18.29 kg for Saanen × Hair goat crossbred kids reported by Akdağ et al. [21]. In this study, the differences among the birth year, sex and dam's age groups were found to be statistically significant in terms of the 90th day weight (P < 0.05). Various studies have revealed that sex [7,8,19,22,23] and the dam's age [6,19,20,22,24] have a statistically significant effect (P < 0.05) on the growth rate of kids during weaning period.

The multiple birth rate among the reproductive traits examined in the study has been strictly followed as of the first year of the project. The Hair goat shepherds do not favour twin births. The hair-goat production system is an extremely extensive form of goat production and the kid prices are relatively low. On the one hand, the survivability of twin kids are lower than the singles, secondly, in general, the twins grow worse than the singles, which is impossible in does with twin kids. These explanations could be the reasons for farmers to avoid twins. The twin birth rate of the flocks examined within the scope of the project, was generally determined as 5.1% although it varied based on years. This twin birth rate was lower than results of some studies [7,13,25,26]. In the present study, the litter size was found as 1.05 in general and this value was compatible with 1.1 specified in the Domestic Animal Catalogue [2] for Hair goats and 1.09 reported by Atay et al. [25].

In the study, it was determined that the 90th day survival rate was 92.70%–97.02% and changed by the years. The kids' survival rate increased to 97.02% in the fifth year as a result of the trainings and information activities provided to the shepherds after the second year of the project. This rate obtained in the present study was higher than the values reported by Oral Toplu and Altınel [6], Şengonca et al. [7], Şimşek and Bayraktar [8], Erten and Yılmaz [11], Oral and Altınel [12] and Atay et al. [25] for Hair goat for the same weaning period as well as 95.76% [7], 90.62% [8], 86.20% and 81.25% [17], 96.3% [21] reported for Saanen × Hair goat crossbred kids. This rate was also higher than 92%, 94.8%, and 94.8% reported by Gül et al. [18] for Hatay goat, German Fawn goat × Hair Goat, and Saanen × Kilis goat crossbred goats, 91.7% reported by Akdağ et al. [21] for Saanen goats, 83.5% reported by Ceyhan [27] for

Toros Alaca goats and 91.8% reported by Taşkın et al. [28] for Bornova goats, respectively.

Upon the examination of records containing 5-year data, it was clearly revealed that Hair goats reared under extensive conditions had adaptation to the region and breeding system with their survival rate exceeding 90% and yearly average of at least one kid per breeding goat. As a result, it can be said that the high variation determined for birth and weaning weights provides important advantages in improvement of these properties by selection.

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