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ARAŞTIRMA MAKALESİ **RESEARCH ARTICLE**

Reproductive performance and kid growth in Hair goats raised under farmer conditions in Adana Province of Türkiye

Adana ilinde çiftçi koşullarında yetiştirilen Kıl keçilerinde üreme performansı ve oğlak gelişimi

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ABSTRACT

This study was carried out to examine the growth and survival characteristics between birth and weaning (90th day) in kids born in 2020-2022, within the scope of the "National Sheep Breeding and Improvement Project under Farm Conditions" in the villages of the districts of Adana. A total of 15200 Hair goat kids' data were used in the study. After birth, the kid's birth weight, sex, and date of birth were recorded, and on the 90th day, weaning weights were determined. All kids sucked their mothers in the morning and evening and stayed in the pen rest of the day. From the age of about 2 weeks, the kids were fed with oak branches and straw pulp. The kids were fed with oak branches, cotton seed and wheat straw at around two weeks of age. The average birth weight of kids was 3.10 kg in males and 2.98 kg in females; The average weaning weights were found to be 16.05 kg for females and 17.50 kg for males. In terms of live weights at birth and weaning, differences across the birth year, sex, birth type, and maternal age groups were shown to be statistically significant ($P < 0.001$). The survivability of kids was 97.20%, significant by years ($P < 0.05$), but it was not significant in terms of sex, birth type and maternal age ($P > 0.05$). As a result, it has been determined that there is a significant variation among the herds in terms of the fertility of Hair goats and the developmental characteristics of kids, and it has been determined that developmental characteristics are affected by environmental factors.

ÖZET

Bu çalışma, Adana'nın ilçelerine bağlı köylerde yürütülen "Halk Elinde Küçükbaş Hayvan Islahı Ülkesel Projesi" kapsamında, 2020-2022 yıllarında doğan oğlaklarda doğum ve sütten kesim (90. gün) dönemleri arası büyüme ve yaşama gücü özelliklerini incelemek amacıyla yapılmıştır. Çalışmada toplam 15200 baş oğlak verisi kullanılmıştır. Doğumdan sonra oğlaklarda doğum ağırlığı, cinsiyet ve doğum tarihi kayıt altına alınmış ve 90. günde sütten kesim ağırlıkları tespit edilmiştir. Oğlaklar, sabah ve akşam analarını emmişler günün diğer saatlerinde ağılda kalmışlardır. Yaklaşık 2 haftalık yaştan itibaren oğlaklar meşe dalı, saman ve küspe ile beslenmişlerdir. Oğlaklarda ortalama doğum ağırlığı erkeklerde 3.10 kg, dişilerde 2.98 kg; sütten kesim ağırlıkları ortalamaları dişilerde 16.05 kg, erkeklerde 17.50 kg olarak bulunmuştur. Doğumda ve sütten kesim dönemindeki canlı ağırlıklar bakımından doğum yılı, cinsiyet, doğum tipi ve ana yaşı grupları arasındaki farklar istatistiksel olarak anlamlı bulunmuştur ($P < 0.001$). Oğlakların yaşama gücü % 97.20, yıllara göre anlamlı ($P < 0.05$), fakat cinsiyet, doğum tipi, ana yaşı bakımından istatitiki olarak önemsiz bulunmuştur ($P > 0.05$). Sonuç olarak, Kıl keçilerinin döl verimi ve oğlakların gelişim özellikleri açısından sürüler arasında önemli bir varyasyon olduğu tespit edilmiş ve oğlaklarda büyüme ve gelişim özelliklerinin çevresel faktörlerden etkilendiği belirlenmiştir.

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INTRODUCTION

Agriculture has proved its industrial importance with the business opportunity, food, and living resources it offers to people around the world. The best proof is provided by the fact that many foods and other goods needed by people today are derived from plants and animals.

Türkiye, which hosts different cultures in agricultural production, has always had a say in the world with its current genetic resources, topographic structure, climate characteristics, rich and fertile lands. In this field, goat breeding is still an important sector and different studies have been carried out on this issue nowadays. (Erten & Yılmaz, 2013;Tekin & Öğeç, 2017; Tekin & Arlı, 2019; Alaşahan & Öztürk, 2019; Elmaz et al., 2020; Güngör et al., 2021; Erdem et al., 2022; Behrem et al., 2022; Ceyhan et al., 2022; Arzık et al., 2023; Gül et al., 2023).

Although Turkey has a serious livestock history, some problems occurred in production in different periods and these problems have rapidly been overcome because of critical decisions taken. Especially in the early 2000s, the number of small ruminants showed a significant decline compared to previous years. To solve these problems, the project titled “National Animal breeding under Farm Conditions” conducted by the General Directorate of Agricultural Research and Policies (TAGEM) of Republic of Türkiye Ministry of Agriculture and Forestry in 2005, breeders were supported, and the number of animals and production started to increase again. In this context, with the support in 2015 and continuing project named “Improving Hair Goats under Farm Conditions in Adana, goat breeding has started to revive again. Hair goat, an indigenous breed, has had the opportunity to be bred in every region of Anatolia and can yield in all kinds of harsh conditions. It is mostly breeding in the areas of the Mediterranean region, forested, mountainous and maquis, and consisted of 97% of 12.324.928 heads native goat breeds (TURKSTAT, 2022).

In animal breeding, sustainability needs to increase the quality and quantity of the yield to be obtained from one offspring per year from each mother. Detection of environmental factors that affect yield and the correct calculation of these effects will increase the accuracy of selection. Birth weight is one of the most important parameters for effective selection and breeding in classical and modern breeding methods. Because this parameter is a factor that directly affects the viability and weaning weight of the offspring. Therefore, it could be said that the follow-up of the development characteristics in flocks of offspring and the annual reproductive trait in the flocks is a mandatory practice in terms of herd management and operating profitability.

The aim of this study was to determine the reproductive efficiency of goats and the growth characteristics of their offspring in the Hair goat breed in Adana province and its districts in 2020-2022.

MATERIALS and METHODS

Study location

The research was carried out in the Taurus Mountains of Adana province located in the south of Turkey. Adana province is surrounded by Kayseri in the north, Osmaniye in the east, Kahramanmaraş in the northeast, Hatay in the southeast, Niğde in the northwest, Mersin in the west and the Mediterranean Sea in the south. Annual rainfall varies between 492.6 - 804.8 mm. In the area, Mediterranean climate is predominant. The winters are mild and rainy, and the summers are hot and dry. Snowfalls and colder temperatures are observed as the altitude rises (Anonym, 2022).

Animal material

The study was performed within the scope of the project named "Improvement of Hair Goats under Farm Conditions in Adana Province-I". All flocks studied in this research were from individual farmers in the region. In this context, data obtained from a total of 13450 heads Hair goats and 15200 kids born from them were used.

Method

At the beginning of the project, all goat and bucks were ear tagged and the age of the animals were recorded. Goat flocks were grazed on the pastures throughout the year and according to the season. In winter and on rainy days, an additional 500 g per animal was fed with a mixture of straw, barley, bran, wheat and corn. Does were mated by a random mating system between July-August. After the birth of the kids, birth weight, sex, birth type, and birth date were recorded within 12 h and were ear tagged. Some descriptive statistics for the study were given in Table 1. The kids were weaned after approximately 90 days of nurturing period by their doe. Weaning weights of kids were corrected according to the 90th day by interpolation method (Erten & Yılmaz, 2013; Tekin & Öğeç, 2017).

Çizelge 1. Kıl keçisi oğlaklarında büyüme özelliklerinin tanımlayıcı istatistikleri

Table 1. Mean descriptive statistics of growth traits in kids of Hair goat

Traits	**BW, kg**	**WW, kg**	**ADG, g**
No. of observation	15200	14771	14771
Mean	3.04	16.78	152.68
Standard deviation	0.77	1.27	11.36
Standard error	0.01	0.01	0.09
Coefficient of Variation	25.33%	7.56%	7.46%
Minimum	1.10	10.17	68.55
Maximum	4.96	59.26	631.70

BW: birth weight, WW: weaning weight, ADG: average daily weight.

Reproductive values were calculated according to the equations given below (Ceyhan et al., 2022);
Fertility rate: (no. of does giving birth / no. of does suitable for mating) x 100
Single kidding rate: (no. of does giving singleborn kids / no of does giving birth) x 100
Twinning rate: (no. of does giving twin-born kids/ no. of does giving birth) x 100
Triplet rate: (no. of does giving triplet-born kids/ no. of does giving birth) x 100
Kid yields per birth: (no. of kids born / no. of does giving birth)
Fecundity: (no. of kids born / no. of does suitable for mating)
Survival rate on day 90th : (no. of weaned kids/ no. of kids live born) x 100

Statistical analysis

SPSS (IBM SPSS 25.0) software was used for the statistical analysis of the data (IBM, 2020). Additive general linear models with fixed effects (year of birth, sex, type of birth, and maternal age) were used to determine the least squares mean of birth and weaning periods of kids. The effects of year of birth, maternal age, sex, birth type and interactions on growth performance were analysed using a generalized linear model (GLM) procedure. When the interaction effects between the groups were examined, there was not any statistically significant difference between the double and triple interactions (P values between 0.07 and 0.277). Therefore, the interaction effects were removed from the model and the model given in Equation (1) was used. The mathematical model is;

$$Y_{ijklm} = \mu + a_i + b_j + c_k + d_l + e_{ijklm} \quad \textbf{Eq.(1)}$$

Y_{ijklm} : i. year, j. mother age, k. birth type, l. sex, m. the weight of the goat for the weighing period,
μ: general average,
a_i: i. effect of year, (2020, 2021, 2022)
b_j: j. effect of mother age (2, 3, 4, 5, 6, 7+)

c_k: k. effect of birth type, (single, twin, triplet)
d_l: l. effect of sex, (male, female)
e_{ijklm}: random residual effects, $\mathrm{N}(0, \mathrm{I}\sigma^2)$ I= identify matrix

To check the significance of the factors examined (in the year and parent age factors with more than two subgroups) Tukey multiple comparison test was used. The chi-Square test was used for the evaluation of fertility traits of the does and survivability of the kids.

RESULTS and DISCUSSIONS

Reproductive traits

The reproductive traits of Hair goats are presented in Table 2. According to this table, it is seen that the reproductive traits of Hair goats differ according to the years.

Çizelge 2. Kıl keçilerinin yıllara göre bazı üreme özellikleri
Table 2. Some reproductive traits of Hair goats by the years

Reproductive characteristics	2020	2021	2022	Overall
Number of does for mating	5022	4923	5138	15083
Number of does giving birth	4324	4459	4664	13447
Fertility (%)	86.10	90.61	91.05	89.26
Fecundity	0.96	1.03	1.04	1.01
Litter size	1.11	1.13	1.14	1.13
Number of single born kid	3831	3863	4006	11700
Number of twins born kid	984	1184	1314	3482
Number of triplets born kid	3	12	3	18
Single kidding rate (%)	79.51	76.36	75.24	76.97
Twinning rate (%)	20.42	23.40	24.70	22.91
Triplet kidding rate (%)	0.06	0.24	0.06	0.12
Survival rates (%)*	98	96	98	97

*Survival rate is calculated at 90th days (weaning weight).

Fertility rates in hair goats varied according to years and were calculated as 86.10%, 90.61% and 91.05%, respectively, during the study. The general average was found to be 89.26%. Fecundity values have increased over the years 0.96%, 1.03% and 1.04% according to the number of goats in does at mating. The litter size values were obtained similarly as 1.11%, 1.13%, and 1.14%. Numbers of single, twin and triplet births have differed over the years. The average single birth, twin birth and triplet birth rates were calculated as 76.97%, 22.91% and 0.12%, respectively.

In the study, although the birth rate was low compared to the number of does for mating goats, it can be said that the multiple birth rate is at a good level. The twinning rate in Hair goats was found to be quite good. Güngor et al. (2021), declared that in their studies on Hair goats, twinning birth rates ranged between 8.7% to 11.4% by the years, Ceyhan et al. (2022) reported the rate of twinning births between 3.5% and 12.4% by the years in the same breed. Our findings show that these flocks are at a good point in terms of multiple births. More offspring per unit animal will increase profitability in livestock enterprises. However, it should be noted that the mother's milk should be at a level that is sufficient for the offspring (Keskin et al., 2022; Gül et al., 2022). By considering weaning weight at

survival, it can be concluded that the mother's milk is sufficient for their offspring. The growth characteristics of Hair goat kids are given in Table 3 by the year, maternal age, sex and birth type.

Çizelge 3. Kıl Keçisi oğlaklarında yıl, cinsiyet, doğum şekli ve çağlarına göre büyüme performansının en küçük kareler ortalaması ve standard hatası

Table 3. The least-square means and standard error of the growth performance in kids by the year, sex, birth type and age

Year	**n**	**BW** (kg)	**n**	**90. days** (kg)	**ADG (g)**
2020	4818	3.03±0.01^{a}	4728	16.38±0.02^{a}	148.35±0.18^{a}
2021	5059	3.08±0.01^{b}	4844	16.95±0.02^{b}	154.05±0.15^{b}
2022	5323	3.01±0.01^{a}	5199	16.99±0.02^{b}	155.35±0.14^{c}
P		0.000 ***		0.000 ***	0.000 ***
Sex					
Male	7652	3.10±0.01	7445	17.50±0.01	159.98±0.1
Female	7548	2.98±0.01	7326	16.05±0.01	145.26±0.1
P		0.000 ***		0.000 ***	0.000 ***
Birth Type					
Single	11700	3.10±0.01^{b}	11375	16.83±0.01^{b}	152.55±0.11^{b}
Twin	3482	2.84±0.01^{b}	3379	16.62±0.02^{b}	153.13±0.18^{b}
Triplet	18	2.49±0.01^{a}	17	15.99±0.29^{a}	149.41±2.98^{a}
P		0.000 ***		0.000 ***	0.017 *
Age of mother					
2	3234	3.01±0.01^{a}	3131	16.61±0.02^{a}	151.08±0.20^{a}
3	3324	3.10±0.01^{b}	3226	16.84±0.03^{b}	152.57±0.24^{b}
4	3150	3.03±0.01^{a}	3075	16.84±0.02^{b}	153.42±0.19^{bc}
5	2203	3.05±0.02^{ab}	2131	16.83±0.03^{b}	153.02±0.24^{bc}
6	1644	3.04±0.02^{ab}	1601	16.83±0.03^{b}	153.26±0.26^{bc}
7≤	1645	2.99±0.02^{a}	1607	16.78±0.01^{ab}	153.58±0.27^{c}
P		0.000 ***		0.000 ***	0.000 ***
Overall	15200	3.04±0.01	14771	16.78±0.01	152.68±0.09

Letters within the same column shows significant difference between means (***P < 0.001, **P < 0.01, *P < 0.05).

As seen in this table, it has been determined that except birth weight, weaning and daily live weight gain increases vary according to year. The differences between the years of these characteristics may be due to the effects of the season or climatic conditions as well as factors such as care, feeding, the condition of the pasture. Birth weights of hair goat kids were affected by sex. As expected, the birth weights of the male kids were higher than the females and the numerical difference between them was statistically significant (P < 0.001). Birth weight was 3.10 ±0.01 kg in male kids and 2.98±0.01 kg in females. Weaning weight and average daily weight gains were also affected by gender in Hair goat kids (P < 0.001).

The birth weights of kids were affected by birth type. Single-born kids took a heavier value than twins and triplets (3.10±0.01 kg vs 2.84±0.01 kg). However, the numerical difference between single and twins in terms of birth weight was found to be statistically insignificant (P < 0.001). The difference between these two groups and the triplets (2.49±0.01 kg) was statistically significant (P < 0.05).

The effect of birth type was also manifested in weaning and daily gains weight. In terms of these two developmental characteristics, a situation has been shown in favour of single-born kids and there was no statistical difference between single and twin-born kids (P > 0.05). The numerical difference between these two birth types and triplets

was statistically significant (P < 0.01). It has been determined that the age of the mother affects the birth weight of the kids in Hair goats. Although there was not any worthy numerical difference between age groups, these results were found statistically significant (P < 0.05). According to maternal age, the lowest birth weight was obtained from gave birth at the age of 7 and above (2.99± 0.02 kg), while the highest birth weight was obtained from gave birth at the age of three (3.10± 0.01 kg). The average birth weight of Hair goat kids was 3.04± 0.01 kg, weaning weight was 16.78± 0.01 kg, and daily live weight gain was 153.58± 0.27 g.

Erten & Yılmaz (2013), Çelik & Olfaz (2018), Elmaz et al. (2022), and Erdem et al. (2022) reported that maternal age, birth type and sex had a significant effect on birth and weaning weights in their study on Hair goats. The average birth weight and weaning weight in Hair goats were reported by Alaşahan & Öztürk (2019) as 3.11 kg and 16.16 kg, Güngör et al. (2021) as 3.17 kg and 15.81 kg, Elmaz et al. (2020) as 3.33 kg and 17.55 kg, Erdem et al. (2022) as 2.36 kg and 15.04 kg, Ceyhan et al. (2022) as 2.52 and 13.68 kg. It may be said that the reason for the numerical differences between the studies may be due to environmental factors, care and feeding and inter-regional variation. Also, the differences between the birth and weaning weights according to the years may have been caused by the seasonal conditions in the region, the plant vegetation status of the pastures and the changes in the care-feeding conditions of the herds.

Survival rate

Table 4 shows the effects of year, maternal age, sex and birth type on some growth characteristics of kids. According to this table, it was determined that years affected the survivability of kids (P<0.05).

Çizelge 4. Kıl Keçisi oğlaklarında sütten kesme çağında yaşama gücü oranı (90 gün)
Table 4. Survival rates of kids at weaning age (90 days)

Factors	Number of born kids	Number of kids alive in weaning	Survival rates %
Year			
2020	4818	4728	98.1[a]
2021	5059	4844	95.8[b]
2022	5323	5199	97.7[ab]
P***			0.000
Sex			
Male	7548	7326	97.1
Female	7652	7445	97.3
P			0.380
Birth type			
Single	11700	11375	97.2
Twin	3482	3379	97
Triplet	18	17	94.4
P			0.669
Age of mother			
2	3234	3131	96.8
3	3324	3226	97.1
4	3150	3075	97.6
5	2203	2131	96.7
6	1644	1601	97.4
7≤	1645	1607	97.7
P			0.192
Overall	15200	14771	97.2

Letters within the same column shows significant difference between means (***P < 0.001, **P < 0.01, *P < 0.05).

Survival rates were calculated as 98.1% in 2020, 95.8% in 2021 and 97.7% in 2022. It was determined that there was no effect of sex and birth type on the viability of the kids at weaning (P > 0.05). Similarly, it was determined that the age of the mother had no effect on the survivability of kids at weaning (P > 0.05).

These results we obtained from this study were in line with the reports of other researchers working on Hair goats (Şengonca et al., 2003; Toplu & Altınel, 2008; Erten & Yılmaz, 2013, Çelik & Olfaz, 2018; Güngör at al., 2021; Elmaz et al., 2022). Differences between studies may be due to genetic variation between regions and environmental factors.

In conclusion, in the study the effects of birth and weaning weights on growth performance of the year, sex, birth type and maternal age were investigated. Accordingly, it has been determined that different environmental factors can be effective on fertility and developmental characteristics in Hair goats. In addition, our results were found to be quite different from the other studies on fertility and growth performances in Hair goats. These differences are thought to be due to the climate differences between the study areas, the condition of the pastures, the size of the herd, the maintenance and feeding conditions, as well as the breeding program implemented in the project and the selection. As a result, it is thought that productivity and farm profitability will increase further if the genetic breeding program, taking into account environmental factors, is continued in Hair goat herds in Adana.

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STATEMENT OF CONFLICT OF INTEREST

The author declares no conflicts of interest.

AUTHOR'S CONTRIBUTIONS

Author-1 performed project administration, and supervision, Author-2 collected the data, Author-3 data curation, and performed the statistical analysis, methodology, and writing of the original draft, and Author-4 writing review and editing, All authors read and approved the final article.

STATEMENT OF ETHICS CONSENT

Ethical approval is not applicable, because this article does not contain any studies with human or animal subjects.

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