

Some production traits and phenotypic relationships between udder and production traits of Hair goats

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ABSTRACT

The study was conducted to determine the production characteristics and to find out the phenotypic relationships between udder and milk production traits in Hair goats. A total of 403 Hair Goats under extensive conditions of Çine town of Aydın province of Turkey were constituted the animal material of the study. The live weights of all goats were recorded just before breeding season. Milk was measured in every month according to the basis of morning or evening milking in a day to estimation of milk yields. Live weights of kids were recorded monthly intervals. Measurements for udder characteristics were determined for two times at 30th and at 180th of the lactation period. Average lactation length, lactation milk yield and daily milk yield of goats were 192.4 days, 139.1 kg and 0.7 kg, respectively. The live weights at birth, 30th, 60th, 90th and 120th days of goat kids were 3.1, 8.6, 13.9, 19.1 and 24.5 kg, respectively. Mean values of withers height, body length and live weight of goats were measured as 73.2 cm, 71.3 cm and 54.5 kg, respectively. Udder and teat characteristics of goats were found positively correlated with milk production characteristics both 30th and 180th days of the lactation period. It can be concluded that Hair goats in extensive conditions had a substantial level of milk yield and their kids had sufficient levels of live weight gains. Furthermore, the udder measurements at the beginning of the lactation could be used for identifying the differences among does.

Key words: Body measurement, Goat, Growth, Milk yield, Phenotypic relationships, Udder characteristics.

INTRODUCTION

The goat population in Turkey is estimated at 10.3 million, of which approximately 9.5 million are Hair goats (Türkstat, 2016). Hair goat constitutes approximately 92% of the goat population in the country. Generally it is accepted that productivity of Hair goats is very low. The goats in extensive conditions of rural areas are favourably characterised by its adaptation to harsh environmental conditions. They are also well known to tolerate extreme temperatures, diseases and poor feeding conditions. The breeders in rural areas normally graze their goat flocks mostly villages in the forests or near to forests. The main income in a goat farm comes from sales of the male kids after 5-6 months of age and the secondly, milk is important product for making traditional cheeses. In order to develop the dairy characteristics of the goats, udder characteristics might be used in selection programs in a simple way. Even though there are some studies (Sengonca *et al.*, 2003; Oral and Altinel, 2006; Toplu and Altinel, 2008; Atay *et al.*, 2010; Gökdal *et al.*, 2013; Erten and Yilmaz, 2013; Çelik ve Oflaz, 2015) conducted to this purpose, obviously a greater number of studies is required especially in rural conditions. The twinning rate of this breed is between 10–20%, and the body weight of the does 39–55 kg. Birth weight and weaning weight for Hair goat kids were reported as between 2.3-3.5

and 12.0-15.5 kg, Lactation milk yield and lactation length of Hair goats were reported as 63-160 kg and 132-215 days, respectively (Sengonca *et al.*, 2003; Türk *et al.*, 2005; Oral and Altinel, 2006; Toplu and Altinel, 2008; Atay *et al.*, 2010, Gökdal *et al.*, 2013; Erten and Yilmaz, 2013; Çelik and Oflaz, 2015). But the number of the studies revealing the production and the udder characteristics of Hair goats under different raising conditions are inadequate.

The purposes of this study were (1) to determine the production and morphological characteristics of Hair goats (2) to investigate the phenotypic relationships between udder and dairy characteristics of the goats in rural conditions.

MATERIALS AND METHODS

Location of the study: The study was carried out in breeders' flocks in Kavsit Village (latitude 37° 65' E, longitude 28° 13' N). It is a forest side village altitude 700 m at the approximately 10 km from Çine district of Aydın city in Southern Aegean Region of Turkey.

Animals and performance recording: A total of 403 Hair goats in rural conditions were constituted of the animal material of the study. The growth characteristics were determined in 57 goat kids. All goats were weighed and their live weights were recorded just before breeding season. At

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the same time, body measurements were measured using by measuring tape and measuring stick.

After the kidding, milk was measured in every month according to the basis of morning or evening milking in a day to estimation of milk yields. Kids were separated from their mothers in about 12 hours before the milk controls in monthly intervals (one month in morning, another month in evening). Goats with a daily milk yield fall below 100 g were considered to be in dry period. Total lactation milk yield of goats was estimated directly from the single milking record (AT method) of International Committee for Animal Recording (ICAR, 2008).

Kids were weighed in 24 hours after birth and numbered with ear tags. Subsequently, live weights of kids were recorded monthly intervals and live weights of kids for days 30, 60, 90 and 120 were calculated by linear interpolation. Hair weights of goats were determined by weighing after shearing with scissors.

Body and udder measurements: Body measurements of does were measured before the breeding season. Measurements for udder characteristics were determined for two times at the beginning (30th day) and at the end (180th day) of the lactation period. Udder measurements were measured in one hour before milking. Measuring tape was used for udder circumference (UC), udder height (UH), udder depth (UD), udder lateral circumference (ULC) and distance between teats (DBT) and caliper was used for teat lengths (TL) (left-right) and diameters (TD) (left-right) (Mavrogenis *et al.* 1988). Udder volume (UV) was calculated with the method reported by Emediato *et al.* (2007). Udder conformation (UC) was determined in the middle of lactation (90th day) (Mavrogenis *et al.* 1988).

Statistical analyses: Analyses of variance were conducted using generalised linear models (GLM). Phenotypic correlations among udder and milk yield characteristics were

calculated PROC CORR procedure (SAS, 1998). Duncan's multiple range test was used to determine the differences among means.

The mathematical models included following fixed effects;

- 1) The age of doe, year, birth type and random effect due to residual error for lactation length, lactation milk yield and daily milk yield of goats.
- 2) The age of dam, sex, birth type and random effect due to residual error for growth traits of kids.
- 3) The age of doe, farm and random effect due to residual error for hair yield, live weights and body measurements of goats.
- 4) The age of doe, lactation period, birth type and random effect due to residual error for udder characteristics.

RESULTS AND DISCUSSION

Production traits: Lactation length (LL), lactation milk yield (LMY) and daily milk yield (DMY) were found as 192.4 days, 139.1 kg and 0.7 kg, respectively (Table 1). The effect of age was significant on DMY ($P<0.01$). The effects of both age and year were significant on LMY ($P<0.01$). The lactation milk yield of goats was highest at 6 years of age.

Hair yield averages of the goats were found as 361.4 g (Table 1). Six year-old does have the highest hair yield ($P<0.05$)

In the present study, longest LL was seen in the 7 years old goats and above, highest LMY was seen in the 6 years old goats. The significance effects of year on LL and LMY can be explained by the fact that the first year of the study was far more arid compare to the second year. In previous studies (Sengonca *et al.*, 2003; Ata, 2007; Simsek and Bayraktar, 2006; Toplu and Altinel, 2008a), LMY, DMY and LL of the Hair goats were reported 63-160 kg, 0.45-0.90 kg and 132-215 days, respectively. The main reason of these variations could be management and ecological

Table 1: Least squares means (\pm S.E.) of lactation length (LL), lactation milk yield (LMY), daily milk yield (DMY) and hair yield (HY) of Hair goats.

Traits	n	LL (day)	LMY (kg)	DMY (kg)	n	HY (g)
Age			**	**		
2	21	181.3 \pm 5.6	99.8 \pm 13.7 ^c	0.558 \pm 0.06 ^c	12	369.1 \pm 37.9 ^{ab}
3	25	197.2 \pm 5.0	121.9 \pm 12.2 ^{bc}	0.622 \pm 0.05 ^{cb}	13	400.7 \pm 35.4 ^{ab}
4	21	197.0 \pm 5.2	136.5 \pm 12.7 ^{ab}	0.698 \pm 0.05 ^{abc}	14	337.0 \pm 38.5 ^b
5	24	187.2 \pm 4.9	142.0 \pm 11.9 ^{ab}	0.761 \pm 0.05 ^{ab}	7	389.3 \pm 49.2 ^{ab}
6	26	191.1 \pm 4.7	161.8 \pm 11.5 ^a	0.829 \pm 0.05 ^a	6	488.1 \pm 52.90 ^a
7 \geq	26	194.1 \pm 4.6	151.7 \pm 11.3 ^{ab}	0.778 \pm 0.05 ^{ab}	10	287.1 \pm 42.1 ^b
Year		**	**			
1	61	174.2 \pm 3.3	122.4 \pm 8.1	0.704 \pm 0.03	-	-
2	82	208.4 \pm 2.8	148.8 \pm 6.9	0.711 \pm 0.03	-	-
Birth Type						
Single	109	188.2 \pm 2.2	136.3 \pm 5.5	0.719 \pm 0.02	-	-
Multiple	34	194.4 \pm 4.2	134.9 \pm 0.3	0.696 \pm 0.04	-	-
Overall	143	192.4 \pm 2.4	139.1 \pm 5.0	0.719 \pm 0.02	62	361.4 \pm 16.4

** $P<0.01$; a, b, c: differences among age groups with different letters in the same column are statistically significant ($P<0.05$).

conditions in different studies. In this study, LMY and DMY values of Hair goats were determined within reported range but near to the upper limits. LL values are in agreement with the mentioned studies. Hair yield of Hair goats are consistent with those of Özder (2006) who reported that the hair yield of Hair goats were between 300-600 g. In another study (Toplu and Altinel, 2008) reported that hair yield of Hair goats reared in rural conditions of Aydın province in Turkey was 381 g.

In this study, least squares means of live weights and daily live weight gains (DLW) of goat kids at different periods are shown in Table 2. Effects of dam age on birth weight and on 60th day weight were significant ($P<0.05$). Live weights and daily live weight gains of male kids were higher than that of female kids (Table 2) ($P<0.05$ and $P<0.01$). Live weights up to 60th days of single born kids were higher than that of multiple born kids ($P<0.05$ and $P<0.01$). The DLW for 0-120 days in goat kids was determined as 0.17 kg (Table 2). Effect of sex on DLW was found significant ($P<0.01$).

Birth weight and growth characteristics of the goat kids determined in the present study were a little higher than that of values reported for Hair goat kids (Sengonca *et al.* 2003; Simpek and Bayraktar, 2006; Toplu and Altinel, 2008b). The growth of the kids after the 60th day of age was not affected from birth type of the kids. The growth performances of multiple born kids reached to the level of single born kids after 60th day of age. These results are in agreement with those of Toplu and Altinel (2008b) who found that twin kids reached the performances of single born kids at the 90th day. It was reported that DLW ranges between 0.082 kg and 0.147 kg in the previous studies on Hair goat kids (Simsek and Bayraktar, 2007; Koyuncu *et al.*, 2007; Atay *et al.*, 2010; Atay *et al.*, 2011). High DLW value

obtained in this study is remarkable. This result could be attributed to the fact that vegetation was good in the period where the study was conducted. Gökdal (2013) reported that the DWG of Hair goat kids offered daily concentrate supplementation is 0.090 kg. However, scientific studies are required to examine the effects of daily additional concentrate feed after the pasturage on live weight gains of the kids.

Body and udder measurements and phenotypic correlations: The body weight and body measurements of goats in two different farms just before breeding season were presented in Table 3.

The body weights of the goats were found as 54.5 kg. The effects of farm and age on the live weights were significant ($P<0.01$). The values for leg circumference and hearth depth were higher in the Farm 1 ($P<0.01$), while the values for live weight were higher in the Farm 2 ($P<0.01$). Except for leg circumference, there were differences in body measurements between the age groups (Table 3).

Based on body weight and height at withers, Devendra and McLeroy (1982) considered as large breeds those with body weights between 20 and 65 kg and height at withers above 65 cm. With reference to mentioned study, Hair goats can be classified as a large-sized goat breed.

The udder characteristics of the goats are given in Table 4. In the present study, effects of age and lactation period on ULC and TD were found significant. The effect of birth type was significant on TD, TL and UV. Except for TL and UD, there were significant effects of lactation period on investigated udder characteristics. Udder shape is important for udder health and milk yield (Mavrogenis *et al.*, 1988). Percentages of halving udder, too flat udder, asymmetric udder and broken udder shapes of does in lactation period were determined as 53.6%, 14.6%, 28.0% and 3.6%, respectively.

Table 2: Least squares means (\pm S.E.) of live weights and daily live weight gains of Hair goat kids at different periods.

Traits	n	Birth weight	30 th day weight	60 th day weight	90 th day weight	n	120 th day weight (0-120 day)	Daily live weight gain
Dam age		*		*				
2	9	2.6 \pm 0.15	8.0 \pm 0.48 ^b	12.7 \pm 0.7 ^b	18.2 \pm 0.8 ^b	6	23.7 \pm 1.6	0.171 \pm 0.013
3	8	2.9 \pm 0.15	7.7 \pm 0.45 ^b	12.4 \pm 0.6 ^b	17.6 \pm 0.8 ^{ab}	6	23.3 \pm 1.4	0.167 \pm 0.012
4	10	2.7 \pm 0.13	7.8 \pm 0.42 ^b	12.8 \pm 0.6 ^b	18.0 \pm 0.7 ^b	7	25.9 \pm 1.6	0.189 \pm 0.013
5	7	3.1 \pm 0.16	8.4 \pm 0.45 ^b	13.6 \pm 0.6 ^b	18.8 \pm 0.8 ^{ab}	4	23.1 \pm 1.7	0.166 \pm 0.014
6	10	3.0 \pm 0.13	9.3 \pm 0.39 ^a	15.2 \pm 0.5 ^a	20.1 \pm 0.7 ^a	6	26.2 \pm 1.3	0.192 \pm 0.011
7 \geq	13	3.2 \pm 0.11	8.3 \pm 0.33 ^b	13.5 \pm 0.4 ^b	19.0 \pm 0.6 ^{ab}	7	25.9 \pm 1.2	0.189 \pm 0.010
Sex			*	**	**		**	**
Male	32	3.0 \pm 0.08	8.7 \pm 0.24	14.3 \pm 0.3	20.1 \pm 0.4	15	26.4 \pm 1.0	0.193 \pm 0.008
Female	25	2.8 \pm 0.09	7.8 \pm 0.29	12.5 \pm 0.4	17.1 \pm 0.5	21	23.0 \pm 0.9	0.165 \pm 0.008
Birth type		*	**	**				
Single	43	3.3 \pm 0.06	8.8 \pm 0.19	14.2 \pm 0.2	19.2 \pm 0.3	30	24.6 \pm 0.6	0.179 \pm 0.005
Multiple	14	2.5 \pm 0.12	7.7 \pm 0.41	12.5 \pm 0.6	18.1 \pm 0.7	6	24.7 \pm 1.6	0.179 \pm 0.013
Overall	57	3.1 \pm 0.52	8.6 \pm 1.54	13.9 \pm 2.3	19.1 \pm 2.8	36	24.5 \pm 0.6	0.178 \pm 0.004

* $P<0.05$; ** $P<0.01$; ^{a, b}: differences among dam age groups with different letters in the same column are statistically significant ($P<0.05$).

Table 3: Least squares means (\pm S.E.) of body measurements and live weights of Hair goats.

Traits	n	Withers height	Hearth width back of withers	Hearth girth	Legs girth	Hearth depth	Body length	Live weight
Farm					**	**		**
Farm 1	70	73.5 \pm 0.5	21.0 \pm 0.2	93.7 \pm 0.6	62.1 \pm 0.5	32.9 \pm 0.2	71.3 \pm 0.5	52.7 \pm 0.8
Farm 2	71	72.8 \pm 0.5	21.0 \pm 0.2	93.5 \pm 0.6	58.8 \pm 0.5	31.7 \pm 0.3	71.3 \pm 0.5	56.3 \pm 0.9
Age		*	**	**		**	**	**
2	18	70.9 \pm 1.0 ^b	20.0 \pm 0.4 ^c	87.9 \pm 1.3 ^c	58.7 \pm 1.0	29.9 \pm 0.5 ^b	67.3 \pm 1.0 ^c	48.6 \pm 1.7 ^c
3	19	72.6 \pm 0.9 ^{ab}	20.2 \pm 0.4 ^{bc}	91.3 \pm 1.2 ^b	61.3 \pm 1.0	32.2 \pm 0.5 ^a	69.6 \pm 0.9 ^{bc}	52.7 \pm 1.6 ^b
4	23	72.6 \pm 0.8 ^{ab}	21.6 \pm 0.4 ^a	95.1 \pm 1.1 ^a	61.8 \pm 0.9	33.7 \pm 0.5 ^a	71.9 \pm 0.8 ^{ab}	57.3 \pm 1.5 ^a
5	27	74.9 \pm 0.8 ^a	21.8 \pm 0.3 ^a	96.0 \pm 1.0 ^a	61.2 \pm 0.8	32.3 \pm 0.4 ^a	73.2 \pm 0.7 ^a	56.5 \pm 1.3 ^{ab}
6	25	73.5 \pm 0.8 ^{ab}	21.4 \pm 0.3 ^a	95.7 \pm 1.0 ^a	60.0 \pm 0.8	32.8 \pm 0.4 ^a	72.5 \pm 0.8 ^a	57.4 \pm 1.4 ^a
7 =	29	74.6 \pm 0.7 ^a	21.2 \pm 0.3 ^{ab}	95.7 \pm 0.9 ^a	59.9 \pm 0.8	33.0 \pm 0.4 ^a	73.0 \pm 0.7 ^a	54.5 \pm 1.3 ^{ab}
Overall	141	73.2 \pm 0.3	21.0 \pm 0.1	93.6 \pm 0.4	60.5 \pm 0.3	32.3 \pm 0.2	71.3 \pm 0.3	54.5 \pm 0.6

*:P<0.05 **:P<0.01.

In the present study, the values of udder characteristics of Hair goats are in agreement with a study done by Simsek *et al.* (2006). High percentage of asymmetric udder type in the goats may be related with the fact that breeders do not make a selection sensitive to milk yield in flocks. Moreover, this udder type may be seen as a result of udder laceration and due to mastitis. Since breeders do not have a practice like early weaning and milking, milking is started after marketing kids when they are about 5-6 months of age. Goat's milk is mainly used for kid rearing in rural goat flocks (Atay *et al.*, 2011). Milking is realized within a short time after the kid marketing towards the end of lactation. A significant part of the breeder's income is obtained from kid sales (Atay *et al.* 2010).

Phenotypic correlations between udder characteristics and milk yield characteristics in 30th and 180th day are given in Table 5.

As seen in Table 5, at the 30th day of lactation, positive correlations were found between LL and ULC (P<0.05). The correlations between LMY and ULC, TD, TL, UL were significant (P<0.05, P<0.01). DMY was found positively correlated with TD, TL and UC. The positive correlations between UV and LMY and between UV and DMY were found significant (P<0.01 and P<0.05, respectively) (Table 5). At 180th day of lactation period, correlation coefficients between LMY and TD (P<0.05) and between LMY and TL (P<0.01) were significant. The relationship between DMY and TL was also significant (P<0.05) at the end of the lactation period.

These findings are consistent with those of other researchers (Mavrogenis *et al.*, 1988; Mavrogenis *et al.*, 1989; Peris *et al.*, 1999; Simsek *et al.*, 2006; Emediato *et al.*, 2008; Kominakis *et al.*, 2009) who found that the correlations between milk yield and udder characteristics in goat and sheep were significant. In the current study, correlation analysis suggested that udder measurements and

udder volume were significantly correlated with milk yield characteristics at 30th and 180th days of lactation. Udder measurements and udder volume parameters were useful in selection programs for identifying differences among does at the beginning of the lactation.

One of the fundamental recommendations for the improvement in goat breeding in Turkey is crossbreeding of Hair goats with appropriate dairy goats according to different regions. It is stated that kid and milk yield can be increased with such crossbreeding studies (Kaymakçi *et al.* 2005). Even though this is right for farms with appropriate conditions, such studies cannot be aimed in all rural goat farms. As shown in the current study, the high level determined for lactation milk yield and daily live weight gain of Hair goats in extensive production conditions are remarkable. But, there is no fundamental approach concerning the sustainability of goat breeding in rural conditions of Turkey. It may be advised pure breeding to improve of milk and growth characteristics of the goats. Implementation of selection, health protection, additional feeding at critical periods and different kid rearing systems by breeders must be ensured in farms which have to sustain the rural goat breeding. Moreover the effects of feeding to be made in addition to pasture must be examined with studies including the economic analysis in rural farms.

In conclusion, the present results showed that Hair goats reared in rural conditions have an important potential in terms of milk yield and growth characteristics. In order to use this potential, the future studies should include the selection programs to improve milk yield characters of Hair goat. In the selection programs, the udder measurements at the beginning of the lactation could be used as selection criteria.

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Table 4: Least squares means (±S.E.) of udder characters of Hair goats.

Traits	n	ULC (cm)	TD (cm)	TL (cm)	DBT (cm)	UD (cm)	UH (cm)	UC (cm)	UV (cm ²)
Age									
2	15	29.3±1.1 ^c	3.7±0.2 ^{bc}	5.6±0.3	7.5±0.6	18.3±0.6	35.2±1.1	40.6±1.2	2515.2±180.8
3	24	29.9±0.8 ^{bc}	3.0±0.2 ^c	5.4±0.3	7.5±0.5	18.2±0.5	36.8±0.8	41.7±0.9	2630.3±141.4
4	18	33.1±0.9 ^a	3.0±0.2 ^{bc}	5.8±0.3	8.0±0.5	19.4±0.5	33.1±0.9	40.3±1.0	2645.9±151.9
5	23	30.4±0.8 ^{bc}	3.9±0.2 ^{ab}	6.3±0.3	6.9±0.5	18.3±0.5	35.2±0.8	40.6±0.9	2464.5±141.7
6	22	32.0±0.8 ^{ab}	4.0±0.2 ^a	6.4±0.3	7.1±0.5	18.6±0.5	33.8±0.8	43.0±0.9	2842.8±141.0
7 =	27	31.6±0.7 ^{ab}	3.5±0.2 ^{ab}	5.9±0.2	7.6±0.4	19.6±0.4	34.7±0.7	40.9±0.8	2727.5±123.9
		**	*		**		*	**	**
Lactation period									
30 th day	62	33.3±0.5	3.7±0.1	5.7±0.1	8.4±0.3	19.0±0.3	34.1±0.5	46.7±0.6	3352.8±91.0
180 th day	67	28.7±0.5	3.3±0.1	6.1±0.1	6.5±0.3	18.4±0.3	35.6±0.5	35.6±0.5	1922.6±85.0
			**	**					*
Birth Type									
Single	94	30.6±0.4	3.1±0.1	5.5±0.1	7.5±0.2	18.5±0.2	34.9±0.4	40.5±0.4	2499.6±67.8
Multiple	35	31.4±0.7	3.9±0.1	6.3±0.2	7.3±0.4	19.0±0.4	34.7±0.7	41.9±0.8	2775.8±118.7
Overall	129	30.8±0.4	3.3±0.1	5.7±0.1	7.4±0.2	18.6±0.2	34.9±0.3	40.7±0.6	2555.3±85.4
Udder conformation									
(%)	82	Halving	too flat	asymmetric	28.0	broken	3.6		
		53.6	14.6						

*P<0.05; ** P<0.01; a, b, c: differences among age groups with different letters in the same column are statistically significant (P<0.05).

ULC: udder lateral circumference TD: teat diameter TL: teat length DBT: distance between teats UD: udder depth UH: udder height

UC: udder circumference UV: udder volume

Table 5: The phenotypic correlations among udder characters and milk yield characters of Hair goat at 30th (below diagonal) and 180th days (above diagonal) of lactation period (n=62).

	ULC	TD	TL	DBT	UD	UH	UC	LL	LMY	DMY	UV
ULC											
TD	0.112										
TL	0.170	0.855**									
DBT	0.403**	0.399**	-0.385**								
UD	0.319**	0.141	0.154	0.099							
UH	-0.483**	-0.141	-0.168	-0.176							
UC	0.328**	0.074	0.035	0.034**							
LL	0.283*	0.148	0.123	0.007	0.046						
LMY	0.279*	0.438**	0.385**	0.020	0.040	0.070					
DMY	0.210	0.412**	0.364**	0.018	0.029	0.378**	0.283*				
UV	0.456**	0.139	0.111	0.335**	-0.554**	-0.178	0.371**	0.028	0.960**	0.953**	0.170
									0.325**	0.311*	0.169

*P<0.05; ** P<0.01. The abbreviations were defined in Table 1 and Table 4.

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