



RESEARCH ARTICLE

The determination of some morphological traits and phenotypic correlations of Turkish Hair goat (Kıl keçisi) breed reared in extensive conditions in Turkey

Özkan Elmaz*, Mehmet Çolak, Aykut Asım Akbaş, Özgecan Korkmaz Ağaoğlu, Mustafa Saatçı

Department of Animal Science, Faculty of Veterinary Medicine,
Mehmet Akif Ersoy University, 15030, Burdur, Turkey

Received: 12.11.2015, Accepted: 18.12.2015

*elmaz@mehmetakif.edu.tr

Türkiye’de ekstansif koşullar altında yetiştirilen Kıl Keçisi-nin bazı morfolojik özellikleri ile fenotipik korrelasyonlarının belirlenmesi

Eurasian J Vet Sci, 2016, 32, 2, 94-100
DOI:10.15312/EurasianJVetSci.2016215518

Öz

Amaç: Bu çalışma ekstansif koşullarda yetiştirilen Kıl Keçilerinin vücut ölçüleri, testis özellikleri ve meme özelliklerinin belirlenmesi amacıyla yapıldı.

Gereç ve Yöntem: Veriler 17 farklı sürüden toplandı. 675 dişi ile 63 tekedan 17 tane vücut ölçüsü, 12 tane meme ölçüsü ve 6 tane de testis özelliği için veri alındı.

Bulgular: Keçilerinin canlı ağırlık, cidago yüksekliği, göğüs çevresi, göğüs derinliği, sağrı yüksekliği ve vücut uzunluğu sırasıyla 51.2 kg, 74.8 cm, 86.8 cm, 32.9 cm, 75.8 cm ve 80.6 cm olarak tespit edildi. Benzer ölçüler tekelerde sırasıyla 82.8 kg, 86.6 cm, 100.7 cm, 37.7 cm, 8.0 cm ve 93.7 cm olarak belirlendi. Meme uzunluğu, meme genişliği, meme çevresi, meme derinliği, meme başı uzunluğu, meme başı genişliği ve meme başı açısı sırasıyla 7.5 cm, 10.1 cm, 36.1 cm, 18 cm, 5.8 cm, 2.6 cm ve 49.3° olarak belirlendi. Skrotum çevresi ve skrotum uzunluğu sırasıyla 29.9 cm ve 20.5 cm olarak tespit edildi. Dişilerde vücut ölçüleri ve meme özelliklerine (sternum yüksekliği ve meme yerleşim şekli hariç) şehir, sürü ve yaşın etkisi önemli bulundu ($P < 0.01-0.001$). En yüksek fenotipik korelasyonlar canlı ağırlık ve göğüs çevresi arasında; 0.82 (dişi) ve 0.87 (erkek) olarak belirlendi ($P < 0.05$).

Öneriler: Çalışmada geleneksel ekstansif şartlarda yetiştirilen çok sayıda ergin Kıl keçilerin morfolojik özellikleri ve bunlarla ilişkili olabilecek verim özellikleri aynı anda incelenmiştir.

Anahtar kelimeler: Kıl keçisi, vücut ölçümleri, testis özellikleri, meme özellikleri, fenotipik korelasyonlar

Abstract

Aim: The aim of this study was to determine body measurements, testicular characteristics and udder traits in Turkish Hair goat reared under the extensive conditions.

Materials and Methods: The data were collected from 17 different flocks. 17 body measurements, 11 udder and 6 testis traits were recorded from 675 females and 63 bucks.

Results: Live weight, withers height, chest girth, rump height, body length were detected as 51.2 kg, 74.8 cm, 86.8 cm, 32.9 cm and 75.8 cm and 80.6 cm, respectively in female Hair goats. Same measurements were determined to be 82.8 kg, 86.6 cm, 100.7 cm, 37.7 cm and 8.0 cm and 93.7 cm for males. Udder length, udder width, udder girth, udder depth, teat length, teat width and teat angle were detected as 7.5 cm, 10.1 cm, 36.1 cm, 18 cm, 5.8 cm, 2.6 cm and 49.3 grade, respectively. Scrotal circumference and scrotum length were determined as 29.9 cm and 20.5 cm respectively. The effects of area, flock and age were significant for all body measurements and udder traits (except sternum height and udder placement shape) for females ($P < 0.01-0.001$). The highest phenotypic correlation was detected as 0.82 (female) and 0.87 (male) between live weight and chest girth ($P < 0.05$).

Conclusion: Morphological characteristics and the relative production traits of these were investigated in a very large population of traditional reared mature Hair goats.

Keywords: Turkish Hair goat, body measurements, testicular characteristics, udder traits, phenotypic correlations



Introduction

Each species has formed different characteristics to live in its own habitat. In farm animals, these characteristics are vitally important in the stages of production, reproduction and adaptation. The importance of each stage is defined according to animal, production system and the rearing area. Extensive rearing structure of Turkish Hair goats might be assessed with these stages. In this structure, the Hair goat, which is the eldest species of Anatolia, plays the most important role. Therefore, more information are needed in order to clarify the identification of Turkish Hair goat. Actually, nomadic Hair goat breeding is a special sector in Anatolia; not only as a livestock production in forest related areas but also a part of cultural and social life (Koyuncu 2005).

According to Turkish Statistical Institute, goat population in Turkey is about 10.1 million (TUIK 2013). Turkish Hair goat (Turkish Native, Anatolian Black, Kıl keçisi) is mainly spreading among all the regions. But this breed concentrated especially in Mediterranean, South-East Anatolia and South-West Anatolia regions. Hair goats have generally a middle-sized body. They are well adapted to all climate and rangeland conditions of Turkey. Additionally, they are able to utilize land covered with different bush and shrub (GDAR 2009). These mentioned characterisations are vital for animal production and considered as a valuable local genetic resource. Definition of the variation among the morphological trait is the first step to evaluate these characterisations. Easily measured traits such as body specification, growth rate, body condition and live weight can be widely used for this aim (Traore et al 2008).

Linear body measurements together with live weight are the most common informative measurements of animal performance of important economic trait in extensive conditions (Riva et al 2004, Adeyinka and Mohammed 2006, Salako 2006).

Besides, some measurements such as udder and testes traits are important for both production and reproduction performance in livestock. In this study, it was carried out in order to determine live weight, body measurements and the correlation between those traits of Hair goat reared under extensive conditions.

Materials and Methods

Location of the study, animals and data collections: The study was conducted in Burdur (latitude 36°53' and 37°50' N, longitude 29°24' and 30°53' E), Antalya (latitude 36°07' and 37°29' N, longitude 29°20' and 32°35' E) and Fethiye (latitude N 36° 37' 18.012" longitude E 29° 6' 59.004"), provinces. This geographical zone is also called as Teke (Buck) Region. Animals in the study were purebred 738 Hair goats from 17

different flocks of the project, titled "Genetic Improvement of Hair Goats in Breeding Condition", which is funded by the General Directorate of Agricultural Research and Policies (GDAR-TAGEM) of the Turkish Ministry of Food, Agriculture and Livestock. Seventeen body measurements, eleven udder and six testis traits were recorded from 675 females aged 2-7 years and 63 males aged 1-4 years. All the flocks were pastured on open range fields and among the forest areas from in the morning until evening. Live weights (LW) of goats were taken with sensitive scales up to 50 g at morning. Body length (BL), withers height (WH), chest girth (CG), chest width (CW), chest depth (CD), rump height (RH), rump width (RW), rump length (RL), distance between withers and rump (DWR), sternum height (SH), head length (HL), head width (HW), ear length (EL), ear width (EW), tail length (TL) and front shank (FS), udder length (UL), udder width (UW), udder girth (UG), udder depth (UD), teat length (TeL), teat width (TW), distance between teat (DT), distance teat-floor (DTP), teat angle (TA), udder placement shape (UPS), udder type (UT) and some testicular characteristics including scrotal circumference (SC), scrotum length (SL), right testes diameter (RTD), left testes diameter (LTD), right testes length (RTL) and left testes length (LTL) of animals were determined according to Adebayo (2009) and Yakubu (2009). Above-mentioned body measurements were obtained by the use of surveyor's stick, measuring tape and digital compass calibrated in centimetres (cm).

Descriptive statistics of the live weight, body measurements, udder traits and testicular characteristics were determined by using Minitab software (2011). ANOVA GLM procedure was also used to examine the effects of factors.

This procedure can be defined as: $Y_{ijkl} = \mu + a_i + b_j + c_k + e_{ijkl}$.

In the model Y_{ijkl} : record of live weight and body linear measurements of each animal,

μ : population mean,

a_i : the effect of area,

b_j : the effect of flock,

c_k : the effect of age,

d_{ijkl} : error term.

Tukey analysis was used to defined differences between subgroups which were significantly important ($P < 0.05$). Additionally, Pearson correlation analysis was also used for the relationships among the traits.

Results

Descriptive statistics of live weight, body measurements and udder traits for females were presented in Table 1. In females; live weight, withers height, chest girth, chest depth, rump height, body length were detected as 51.2 kg, 74.8 cm, 86.8 cm, 32.9 cm, 75.8 cm and 80.6 cm, respectively. The same measu-





rements for males were 82.8 kg, 86.6 cm, 100.7 cm, 37.7 cm, 86.0 cm and 93.7 cm, respectively (Table 2). In the current study some udder traits such as udder length, udder width, udder girth, udder depth, teat length, teat width and teat angle were detected as 7.5 cm, 10.1 cm, 36.1 cm, 18 cm, 5.8 cm, 2.6 cm and 49.3 grade, respectively (Table 1). In bucks; scrotal circumference, scrotum length, right testes diameter, left testes diameter, right testes length and left testes length were determined as 29.9 cm, 20.5 cm, 5.1 cm, 5.2 cm, 11.9

cm and 11.9 cm, respectively (Table 2). Area, flock and age effects were significant for all body measurements and udder traits (except sternum height and udder placement shape) for females ($P < 0.01-0.001$). In males, these effects were different significant levels. Age effect was non-significant on the many measurements (Table 2). The significant correlations estimated between live weights and some morphological traits for females and males were shown in Table 3 and Table 4. Phenotypic correlation coefficients between live weight and

Table 1. Means, standard error of means (SEM), coefficient of variation (CV) and significance of area, flock and age effects for each of the morphological and udder traits in females.

	Females (n=675)				Fixed effects		
	Statistics				Area	Flock	Age
	Mean	±	SEM	CV (%)			
<i>Body Traits</i>							
Live Weight (LW) (kg)	51.2	±	0.33	16.5	***	***	***
Body Length (BL) (cm)	80.6	±	0.20	6.3	***	***	***
Withers Height (WH)(cm)	74.8	±	0.18	6.2	***	***	***
Chest Girth (CG) (cm)	86.8	±	0.20	5.8	***	***	***
Chest Width (CW) (cm)	17.7	±	0.07	10.5	***	***	***
Chest Dept (CD) (cm)	32.9	±	0.10	7.7	***	***	***
Rump Height (RH) (cm)	75.8	±	0.13	4.5	***	***	***
Rump Width (RW)(cm)	18.1	±	0.12	16.8	***	***	***
Rump Length (RL) (cm)	18.7	±	0.09	12.8	***	***	**
Distance between withers and rump (DWR) (cm)	49.2	±	0.16	8.2	***	***	***
Sternum Height (SH) (cm)	40.8	±	0.12	7.5	NS	***	NS
Head Length (HL) (cm)	22.7	±	0.07	7.5	***	***	***
Head Width (HW) (cm)	11.3	±	0.05	10.6	***	***	***
Ear Length (EL) (cm)	16.9	±	0.17	25.7	***	***	***
Ear Widgt (EW) (cm)	8.0	±	0.05	17.7	***	***	**
Tail Length (TL) (cm)	16.6	±	0.09	13.4	***	***	NS
Front Shank (FS) (cm)	9.7	±	0.04	9.9	***	***	***
<i>Udder Traits</i>							
Udder Lenght (UL) (cm)	7.5	±	0.05	17.8	***	***	**
Udder Width (UW) (cm)	10.1	±	0.07	18.6	***	***	***
Udder Depth (UD) (cm)	18.0	±	0.10	14.2	***	***	***
Udder Girth (UG) (cm)	36.1	±	0.16	11.8	***	***	**
Teat Lenght (TeL) (cm)	5.8	±	0.73	32.4	***	***	***
Teat Width (TW) (cm)	2.6	±	0.40	39.2	***	***	***
Distance Between Teat (DT) (cm)	11.3	±	0.08	18.3	***	***	***
Distance Teat-floor (DTP) (cm)	32.1	±	0.18	14.7	***	***	***
Teat Angle (TA) (grades)	49.3	±	0.26	13.4	***	***	***
Udder Placement Shape (UPS) (grades)	3.3	±	0.03	24.6	NS	***	NS
Udder Type (UT) (grades)	2.0	±	0.03	35.7	***	***	***

*Significance level : $P < 0.05$, **Significance level : $P < 0.01$, ***Significance level : $P < 0.001$, NS: Non-Significant



Table 2. Means, standard error of means (SEM), coefficient of variation (CV) and significance of area, flock and age effects for each of the morphological and testicular characteristics in bucks.

	Males (n= 63)				Fixed effects		
	Statistics				Area	Flock	Age
	Mean	±	SEM	CV (%)			
<i>Body Traits</i>							
Live Weight (LW) (kg)	82.8	±	2.16	20.7	***	***	***
Body Length (BL) (cm)	93.7	±	0.86	7.3	**	*	***
Withers Height (WH)(cm)	86.6	±	0.74	6.8	**	NS	**
Chest Girth (CG) (cm)	100.7	±	0.91	7.2	**	**	***
Chest Width (CW) (cm)	21.2	±	0.30	11.2	***	**	***
Chest Dept (CD) (cm)	37.7	±	0.62	13.0	NS	NS	**
Rump Height (RH) (cm)	86.0	±	0.59	5.4	**	NS	***
Rump Width (RW)(cm)	20.2	±	0.48	19.0	***	***	NS
Rump Length (RL) (cm)	21.5	±	0.35	12.9	***	***	NS
Distance between withers and rump (DWR)(cm)	56.0	±	0.54	7.6	*	*	***
Sternum Height (SH) (cm)	45.8	±	0.41	7.1	NS	NS	*
Head Length (HL) (cm)	25.7	±	0.28	8.7	***	***	*
Head Width (HW) (cm)	13.3	±	0.23	13.5	**	***	*
Ear Length (EL) (cm)	18.0	±	0.54	23.9	***	***	NS
Ear Widgt (EW) (cm)	8.6	±	0.16	15.1	***	***	NS
Tail Length (TL) (cm)	19.9	±	0.25	9.8	NS	*	NS
Front Shank (FS) (cm)	12.3	±	0.25	16.3	***	***	NS
<i>Testicular characteristics</i>							
Scrotum Circumference (SC) (cm)	29.9	±	0.39	10.3	***	***	***
Scrotum Length (SL) (cm)	20.5	±	0.38	14.5	*	***	NS
Right Testes Diameter (RTD) (cm)	5.1	±	0.06	10.0	***	***	**
Left Testes Diameter (LTD) (cm)	5.2	±	0.06	9.3	***	***	*
Right Testes Length (RTL) (cm)	11.9	±	0.20	13.6	*	*	*
Left Testes length (LTL) (cm)	11.9	±	0.21	14.0	*	NS	NS

*Significance level: $P < 0.05$, **Significance level: $P < 0.01$, ***Significance level: $P < 0.001$, NS: Non-Significant

body length, withers height, chest width, chest depth, rump height were 0.71, 0.48, 0.34, 0.57, 0.56 and 0.75, 0.69, 0.53, 0.47, 0.64 for females and males, respectively. The coefficients of phenotypic correlations between udder girth and udder depth, udder width, teat angle were detected as 0.70, 0.57, 0.14, respectively. The correlation coefficients between testicular measurements were estimated from 0.41 to 0.93 ($P < 0.05$). According to Table 4, high, positive and significant correlations were estimated as 0.78 between scrotum circumference and live weight ($P < 0.05$).

Discussion

Defined morphological measurements in both male and female Hair goats were higher than the values reported for the same breeds by Cam et al (2010) and for different goat

breeds reported by Bingöl et al (2012), Vargas et al (2007), Wang et al (2011). However, Elmaz et al (2012), reported higher values than the present study for Honamlı goat. Udder traits in the study were generally higher than the values for same breeds reported by Şimşek et al (2006) and for different goat breed reported by Kaya (2005). In contrast, Rupp et al (2011) reported higher values for Teat Length and Teat Width than the current study.

Lower testicular measurements than in this study were reported for Boer bucks (Almeida et al 2007, Keith et al 2009) and Hair goats (Türk et al 2005). Many studies have been conducted to determine the relationship of live weight with linear body measurements (Slippers et al 2000, Khan et al 2006). Phenotypic correlation coefficients between live weight and body length, withers height, chest width, chest



Table 3. Significant ($P<0.05$) phenotypic correlations among all measured traits in females. Correlations higher than 0.30 was in bold.

	LW	BL	WH	CG	CW	CD	RH	RW	RL	DWR	SH	HL	HW	EL	EW	TL	FS	UL	UW	UD	UG	TeL	TW	DT	DTP	TA	UPS
BL	0.71																										
WH	0.48	0.50																									
CG	0.82	0.49	0.38																								
CW	0.34			0.45																							
CD	0.57	0.28	0.28	0.68	0.47																						
RH	0.56	0.49	0.65	0.47	0.09	0.35																					
RW		-0.25	-0.12	0.26	0.82	0.38																					
RL	0.24	0.31	0.27	0.22	-0.19		0.33	-0.27																			
DWR	0.57	0.26	0.24	0.54	0.45	0.57	0.36	0.29	-0.15																		
SH	0.09	0.14	0.36		0.08		0.48		0.17	0.08																	
HL	0.54	0.31	0.22	0.51	0.49	0.47	0.30	0.35		0.48																	
HW	0.53	0.53	0.25	0.38	0.12	0.28	0.32		0.25			0.52															
EL	0.48	0.37	0.28	0.38	0.11	0.32	0.31		0.13	0.38		0.33	0.35														
EW	0.50	0.43	0.28	0.36		0.25	0.31	-0.20	0.21	0.31		0.28	0.34	0.77													
TL	0.30	0.42	0.26	0.16	-0.16		0.32	-0.24	0.13		0.10		0.30	0.16	0.23												
FS	0.41	0.45	0.27	0.28		0.16	0.32	-0.26	0.30		0.11	0.20	0.35	0.33	0.38	0.22											
UL	0.11			0.11	0.21	0.14		0.19	-0.17	0.17				0.12													
UW	0.25	0.17	0.10	0.15		0.09	0.13	-0.19		0.12			0.12	0.27	0.27	0.09	0.20	0.58									
UD	0.30	0.09		0.31	0.27	0.33	0.08	0.22	-0.12	0.31		0.23	0.17	0.24	0.17		0.12	0.65	0.49								
UG	0.23			0.18	0.20	0.19		0.16	-0.15	0.24		0.16	0.13	0.20	0.13		0.09	0.71	0.57	0.70							
TeL	0.19	0.12		0.21		0.16				0.17	-0.11	0.17	0.18	0.10	0.09		0.12	-0.23	-0.09		-0.08						
TW	0.18	0.08		0.20	0.11	0.21			-0.13	0.25	-0.14	0.19	0.17	0.15	0.14		0.18	-0.09		0.18		0.80					
DT	0.31	0.24	0.12	0.21		0.14	0.15			0.19			0.10	0.18	0.18	0.11	0.17	0.40	0.46	0.38	0.40	-0.13					
DTP	-0.20		0.17	-0.23	-0.15	-0.22	0.28		0.20	-0.18	0.37	-0.24	-0.17	-0.13	-0.09	0.11	-0.09			-0.25	-0.08	-0.58	-0.58				
TA	-0.15	-0.10		-0.12		-0.08		0.15		-0.10		-0.16	-0.16	-0.08	-0.13		-0.19	0.26	0.10	0.08	0.14	-0.56	-0.52	0.35	0.36		
UPS												-0.08	-0.08			-0.08		0.37	0.30	0.22	0.26	-0.41	-0.26	0.27	0.21	0.35	
UT				0.13	0.10	0.16			-0.12	0.16	-0.11	0.14						-0.16	-0.01			0.80	0.83	-0.14	-0.52	-0.48	-0.32

depth, rump height were 0.71, 0.48, 0.34, 0.57, 0.56 and 0.75, 0.69, 0.53, 0.47, 0.64 for females and males, respectively. Similar positive correlations between live weights and body measurements were also reported by some researches (Adeyinka and Mohammed 2006, Khan et al 2006, Vargas et al 2007, Yakubu et al 2011). The highest values were detected as 0.82 and 0.87 between live weight and chest girth as indicated by Cam et al (2010) for Hair goat and by Keith et al (2009), Slippers et al (2000) for different goat breeds. According to this findings and statemens, the chest girth could be useful to estimate the live weight of Hair goats. Comparable to the corresponding study, Simsek et al (2006) reported the strong, positive and significant phenotypic correlation coefficients between udder depth and udder girth; teat length and teat diameter were 0.71 and 0.86 for Turkish Hair goats, respectively. In the same research, negative correlations were detected between udder type and udder traits like the current study. Altincekic and Koyuncu (2011) reported that higher correlations between udder girth and udder length for Tahirova (0.72), Kivrıcık (0.57) and Karacabey Merino (0.52) ewes. The correlation coefficients related testicular measurements were ranged from 0.41 to 0.93. Various correlations with different levels for scrotum measurements were stated by the researchers (Bongso et al 1982, Raji et al 2008, Ugwu

2009). The correlation between live weight and scrotum circumference is one of the most useful measurement (0.63) for the farm species, same value was also reported by Keith et al (2009) for Boer bucks. For this correlation, while lower values ($r=0.67$) were detected by Raji et al (2008) in Red Skoto goats, higher values ($r=0.94$) were reported by Bongso et al (1982) for Saanen and Jamunapari crosses. In the present study, scrotum length and testes length with scrotum circumference found positive and high correlation coefficients ranged from 0.61 to 0.67.

Conclusion

This study was aimed to investigate some morphological traits of native Hair goat breed reared under extensive conditions. This study is the first one in terms of determines the some results of the project, which is called "Genetic Improvement of native Hair Goat in Breeders Condition" in Turkey. This study described the Turkish Hair goat reared under the traditional system with low production level due to lack of care and management in harsh conditions.

In the present study, between live weights and body measurements were detected many positive and significant corre-

Table 4. Significant ($P < 0.05$) phenotypic correlations among all measured traits in bucks. Correlations higher than 0.30 are in bold.

	LW	BL	WH	CG	CW	CD	RH	RW	RL	DWR	SH	HL	HW	EL	EW	TL	FS	SC	SL	RTD	LTD	RTL
BL	0.75																					
WH	0.69	0.66																				
CG	0.87	0.63	0.64																			
CW	0.53	0.32	0.17	0.59																		
CD	0.47	0.42	0.39	0.51	0.37																	
RH	0.64	0.65	0.80	0.55		0.29																
RW					0.69																	
RL					-0.37		0.32	-0.48														
DWR	0.62	0.63	0.54	0.60		0.34	0.63															
SH		0.40	0.45					0.55														
HL	0.35	0.36		0.38	0.62			0.54	-0.36	0.26												
HW	0.53	0.60	0.40	0.36	0.33	0.32	0.33		-0.26	0.42		0.39										
EL	0.47	0.28		0.35																		
EW	0.55	0.39	0.34	0.42			0.32	-0.36					0.29	0.75								
TL							0.45			0.36	0.31											
FS	0.37	0.31	0.28	0.26			0.37	-0.35						0.29	0.51							
SC	0.78	0.52	0.40	0.69	0.60	0.43	0.36	0.27		0.43		0.49	0.41	0.38	0.40							
SL	0.51	0.30	0.26	0.38	0.39		0.31			0.36		0.28	0.39		0.27		0.29	0.61				
RTD	0.55	0.32		0.60	0.70	0.40		0.48		0.27		0.48	0.34	0.29				0.74	0.58			
LTD	0.58	0.33	0.29	0.65	0.72	0.44		0.50		0.29		0.52	0.37	0.29				0.73	0.53	0.93		
RTL	0.63	0.32	0.39	0.53	0.41	0.35	0.41			0.38		0.29	0.29	0.28	0.33			0.67	0.59	0.63	0.64	
LTL	0.48	0.44	0.38	0.38			0.28			0.31		0.28	0.30	0.40	0.31			0.62	0.43	0.48	0.41	0.55

lations. Especially, the highest correlation coefficient between live weight and chest girth can be used in the area as an estimator for live weight for Hair goats. It can also be involved as a criterion for early selection.

Acknowledgments

The authors acknowledgment the General Directorate of Agricultural Research and Policies (GDAR-TAGEM) of the Turkish Ministry of Food, Agriculture, and Livestock. The authors would like to acknowledgment the staff of these projects. This Research was supported by GDAR (General Directorate of Agricultural Research and Policies) within "Genetic Improvement of Hair Goat in Breeders' Condition" projects (Projects No: 2011KIL07-01, 2011KIL15-01, 2011KIL48-01).

References

- Adebayo AT, 2009. Application of principal component factor analysis in quantifying size and morphometric traits of West African Dwarf goats in Oyo State. Nasarawa State University Department of Animal Science Unpublished Postgraduate Diploma Thesis.
- Adeyinka IA, Mohammed ID, 2006. Relationship of live weight and linear body measurements in two breeds of goats of Northern Nigeria. *J Anim Vet Adv*, 5, 891-893.
- Almeida AM, Schwalbach LMJ, Cardoso LA, Greyling JPC, 2007. Scrotal, testicular and semen characteristics of young Boer bucks fed winter veld hay: The effect of nutritional supplementation. *Small Rumin Res*, 73, 216-220.
- Altıncekcik SÖ, Koyuncu M, 2011. Relationship between udder measurements and the linear scores for udder morphology traits in Kıvrıcık, Tahirova and Karacabey Merino Ewes. *Kafkas Univ Vet Fak Derg*, 17, 71-76.
- Bingöl M, Gökdağ O, Aygün T, Yılmaz A, Daşkıran İ, 2012. Some productive characteristics and body measurements of Nerdüz goats of Turkey. *Trop Anim Health Prod*, 44, 545-550.
- Bongso TA, Jainudeen MR, Sitizahrah A, 1982. Relationship of scrotal circumference to age, body weight and onset of spermatogenesis in goats. *Theriogenology*, 18, 513-523.
- Cam MA, Olfaz M, Soydan E, 2010. Possibilities of using morphometrics characteristic as a tool for body weight prediction in Turkish Hair goats (Kıl keçi). *Assian J Anim Vet Adv*, 5, 52-59.
- Elmaz Ö, Saatçı M, Mamak N, Dağ B, Aktaş AH, Gök B, 2012. The determination of some morphological characteristics of honamlı goat and kids, defined as a new indigenius goat breed of Turkey. *Kafkas Univ Vet Fak Derg*, 18, 481-485.
- General Directorate of Agricultural Research and Policies (GDAR), 2009. Domestic Animal Genetic Resources in Turkey, Ankara, Turkey, pp: 82-83.
- Kaya SÖ, 2005. Somatic cell counts and its relationship with some dairy and udder characteristics measurements in white goat. Master Thesis, Ankara University Graduate School of Natural and Applied Sciences Department of Animal Science.
- Keith L, Okere C, Solaiman S, Tiller O, 2009. Accuracy of predicting body weights from body conformation and testicular morphometry in pubertal Boer goats. *Res J Anim Sci*,





- 3, 26-31.
- Khan H, Muhammad F, Ahmad R, Rahimullah NG, Zubair M, 2006. Relationship of body weight with linear body measurements in goats. *J Agric Biol Sci*, 1, 51-54.
- Koyuncu M, 2005. Goat breeding strategy in the World and Turkey. *Proceedings of the National Congress of Dairy Goat*, İzmir, Turkey, pp: 59-65.
- Raji AO, Igwebuike JU, Aliyu J, 2008. Testicular biometry and its relationship with body weight of indigenous goats in a semi-arid region of Nigeria. *JABS*, 3, 6-9.
- Riva J, Rizzi R, Marelli S, Cavalchini LG, 2004. Body measurements in Bargamasca sheep. *Small Rumin Res*, 55, 221-227.
- Rupp R, Clément V, Piacere A, Robert-Granié C, Manfredi E, 2011. Genetic parameters for milk somatic cell score and relationship with production and udder type traits in dairy Alpine and Saanen primiparous goats. *J Dairy Sci*, 94, 3629-3634.
- Salako AE, 2006. Principal component factor analysis of the morph structure of immature Uda sheep. *Int J Morph*, 24, 571-574.
- Simsek UG, Bayraktar M, Gurses M, 2006. Çiftlik koşullarında Kıl keçilerine ait bazı verim özelliklerinin araştırılması. *FÜ Sağlık Bil Derg*, 20, 221-227.
- Slippers SC, Letty BA, De Villiers JF, 2000. Predicting the body weight of Nguni goats. *S Afr J Anim Sci*, 30 (Suppl. 1), 127-128.
- Traore A, Tamboura HH, Kabore A, Royo LJ, 2008. Multivariate characterization of morphological traits in Burkina Faso sheep. *Small Rumin Res*, 80, 62-67.
- TUIK, 2013 Hayvansal Üretim İstatistikleri, Accessed at: 08.07.2014.
- Türk G, Sönmez M, Şimşek ÜG, 2005. Comparison of some reproductive features of pure Hair goat bucks and Saanen x Hair Goat (F1) crossbreed bucks. *FÜ Sağlık Bil Derg*, 19, 87-92.
- Ugwu SCO, 2009. Relationship between scrotal circumference, in situ testicular measurements and sperm reserves in the West African dwarf bucks. *Afr J Biotechnol*, 8, 1354-1357.
- Vargas S, Larbi A, Sánchez M, 2007. Analysis of size and conformation of native Creole goat breeds and crossbreds used in smallholder agrosilvopastoral systems in Puebla, Mexico. *Trop Anim Health Prod*, 39, 279-286.
- Wang DH, Xu GY, Wu DJ, Liu ZH, 2011. Characteristics and production performance of Tianfu goat, a new breed population. *Small Rumin Res*, 95, 88-91.
- Yakubu A, 2009. Fixing collinearity instability in the estimation of body weight from morpho-biometrical traits of West African Dwarf goats. *Trakia J Sci*, 7, 61-66.
- Yakubu A, Salako AE, Imumorin IG, 2011. Comparative multivariate analysis of biometric traits of West African Dwarf and Red Sokoto goats. *Trop Anim Health Prod*, 43, 561-566.