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Investigation of the Effects of Age and Sex on Fiber Characteristics of Iranian Indigenous Goats

Research Article

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ABSTRACT

This study was conducted to investigate the effects of age and sex on the fleece characteristics of 40 Iranian indigenous Khorasan goats. Goats were divided into two different sex and age (kids and adults) groups. Fiber characteristics under study were: fleece weight, fiber length, lock length, fiber diameter, coefficient of fiber diameter, breaking load, resistance, elongation, hair percentage and down fibers percentage. The results showed that sex and age had a significant effect on fleece weight and fiber diameter. The average fleece weight was 214.6 ± 0.5 g in males and 186.9 ± 4.15 g in females while 196.2 ± 15.8 g in kids and 205.5 ± 15.8 g in adults. The average fiber diameter was 88.4 ± 4.5 microns in males and 73.5 ± 3.9 microns in females while 73.4 ± 3.9 microns in kids and 88.5 ± 4.5 microns in adults. The resistances of hair in kids (8±0.9 grf/t) were lower than in adult goats (10.5±0.7 grf/t). Fleeces had down fibers (1-30% with the average amount of 11.1%±2.2), average fiber diameter of 16.4 ± 0.6 micron and coefficient of variation of fiber by 18.3 ± 1.1%. The correlation between fiber length and lock length, resistance and lock length were 0.9 and 0.6, respectively which was considered highly positive. In the overall view, according to the approximately low fleece weight, low fiber length and including of down fibers in the fleece of indigenous Khorasan goats, they are categorized in hair goats with medium quality fleeces.

KEY WORDS age, fiber quality, fleece characteristics, goat, sex.

INTRODUCTION

Generally goats, except Angora goats, have a tow layer fleece (Bilgen, 2008). One of them are including top layer with long and coarse fibers that are responsible for the mechanical protection of the inner layer while another layer is the inner one that is consisted of fine and short fibers being these responsible of protect animal's body temperature. Considering the differences between these two layers, goats are divided into hair and down fibers groups (Nagal, 2006). Production rate of down fibers and hair are dependent on genetic and environmental factors, including breeding systems, temperature, location, altitude, age and gender.

This is why goats reared in tropical areas; produce more hair and less down fibers. Goat hair varies in color (from white to black) and they include a big part of hair goat fleeces. Average hair production is about 1.5 to 2 kg and under good conditions fleece weight could raise up to 3 or 5 kg in females and males, respectively (Salehi *et al.* 2010).

The best fiber length for the industrial use of hair should be about 10 cm. In addition, the coarser fibers are considered the better that exist. Factors such as cleanliness and lower down fibers would have an effect on the production costs, color uniformity within the fleece and low fiber length variation. Hair of goats is normally used for producing carpets, rugs, paint brush, rope and coarse fabrics. Fur-

thermore, the hair of goats is normally used in preparing mortar for strength of concrete, sifting and screening and car safety belt. Khorasan goats produce about 0.33 kg hair fibers and it should be mentioned that the fleece of kids is not sheared during the first year of age. The range of hair production in rural goats is usually going from 0.28 to 0.42 kg. It is reported that there is a flock of rural goats in the south of Khorasan that produce 0.6-1 kg good quality hair fleeces with 80% down fibers fibers (Raofifard *et al.* 2001; Saghi *et al.* 2007). The aim of this study was to evaluate the fleece characteristics of Khorasan native goats and to investigate the effect of environmental effects in the textile quality of their fleeces.

MATERIALS AND METHODS

Fiber samples were collected from 14 kids and 26 adult goats of two different sexes. The length of 50 hair fibers and 5 hair locks was measured separately. In order to determine the percentage of down fibers, the fleeces were scored, rinsed and air dried. A sub-sample was prepared for measurement with the projection microscope in accordance to ASTM D2130 (2001). Over one hundred fibers from each sample were measured. Mean fiber diameter and standard deviation were obtained for each sample and the coefficient of variation (CV) was then calculated. The visual subjective test was used to separate the various fiber types, including down and hair fibers (ISIRI, 2001). The subsample was paralleled so that, an aligned specimen of 15 to 25 mg was available for testing. The protruding end was combed by comb to remove loose fibers and foreign material and to secure partial parallelization of the fibers. The tuft was reversed and combing at the other end was repeated. The clamped tuft was placed in the grips of tensile testing machine (Instron) and it was used 100 kg capacity load cell with the pulling clamps moved at 25 cm/min. After recording the breaking load, the broken fibers were weighed to the nearest 0.01 g and breaking tenacity was then calculated using ASTM D1294 (2005).

Analysis of variance was performed using a general linear model (GLM) of the SAS package (SAS, 2000). The statistical model used for different sex and age groups was:

$$\gamma_{ijk} = \mu + \alpha_i + \beta_j + \alpha\beta_{ij} + e_{ijk}$$

Where:

γ_{ijk} : is individual record.

μ : is population mean.

α_i : is effect of i^{th} sex.

β_j: is effect of j^{th} age.

$\alpha\beta_{ij}$: is interaction between sex and age.

e_{ijk}: is residual effects.

A Pearson correlation test was used to assess the significance of correlation on fiber traits.

RESULTS AND DISCUSSION

The average fleece weight of goats was 199.8 g with the range of 55-665 g (Table 1). Goats had less fleece weight in comparison to other Iranian goat breeds. Other studies indicated that the fleece weight produced by Syrian and Jordanian hair goats were more than fleece weight produced in this study (ACSAD, 1983). The fiber length and lock length in Khorasan goats were 5.7 ± 0.4 and 4.7 ± 0.3 cm, respectively. The average fiber length is one of the most effective factors in determining the price of the fleece, because there is a close relationship between breaking load and fiber length. Longer hairs are more expensive. The fiber length of hair fibers in goats varied widely and in different studies it was reported to oscillate in the range of 6-24 cm, that it was in line with the observations (6-9 cm) in Iranian breeds (Pordel, 2000). The average fiber and lock length reported for Lorestan goats were 6 and 8 cm, respectively while for indigenous goats of Fras province the range was from 5.63 to 8.12am, respectively (Chekini *et al.* 2006; Hezareh-Moghadam and Salehi, 2009). The length of down fibers and hair fibers in Raeini goats was 0.7 and 7.6 cm, respectively (Salehi *et al.* 2010; Ansari-Ranani *et al.* 2012). According to the Iranian standard, hair length should be between 2.5-18 cm in order to classify fleeces as hair fleece (ISIRI, 1998). In the present study, fiber length and lock length were 5.7 ± 0.4 and 4.7 ± 0.3 cm, respectively with a high coefficient of variation (40.8±1.7% and 21.6±1.7%, respectively). These amounts were lower than hair length in comparison to the other indigenous goats (6-9 cm) and foreign goats (12.6-23.5 cm) (Pordel, 2000; Zhou *et al.* 2003; Taherpour, 2004; Chekini *et al.* 2006; Eisazadeh *et al.* 2009; Negahdari *et al.* 2009). The diameter of fibers in Khorasan goats had the average amount of 80.8 ± 3.1 microns (ranging from 56.2 to 128.5 microns) that is placed between hair fibers of goats from Fars province (78.17 microns) and goats from Lorestan province of Iran (82.96 microns) (Chekini *et al.* 2006). It could be said that Khorasan goats are favored because of the diameter of hair fibers. In the present study, considerable range of hair fibers was seen (1.20-14.40 microns) with the resistance of 10.25 ± 0.33 grf/tex. The results illustrated that the age of goats (kids and adults) had an influence on some fiber characteristics such as the mean of diameter, the fleece weight and the hair resistance but it had no significant effect on the fiber and lock length, their coefficient variation and the hair tenacity (Tables 2, 3 and 4).

Table 1 Statistics of fiber characteristics in hair Khorasan goats

Trait	N	Mean±SE	CV (%)	Minimum	Maximum
Fleece weight (g)	99	199.8±11.4	55.7	55	665
Fiber length (cm)	41	5.7±0.4	43.2	2.8	12.3
CV of fiber length (cm)	41	40.8±1.7	26.7	17.5	65.3
Lock length (cm)	41	4.7±0.3	48.3	2.2	10.6
CV of lock length (cm)	41	21.6±1.7	50.9	0.0	46.8
Fiber diameter (micron)	41	80.8±3.1	24.7	56.2	128.5
CVF (%)	41	31.1±1.3	27.9	13.8	58.6
Breaking load (gf)	26	7.2±0.4	26.5	3.6	9.9
Resistance (gf/Text)	26	9.7±0.6	30.6	1.2	14.4
Elongation (%)	26	13.9±1.1	41.9	8.0	37.3

CV: coefficient of variation.

Table 2 The effect of fixed factors on the fiber characteristics of hair Khorasan goats

Traits	N	Fiber length (cm)	CV of fiber length (%)	Lock length (cm)	CV of lock length (%)	Fiber diameter (micron)	CVF (%)
				Age			
Significant		NS	NS	NS	NS	**	NS
Kids	16	5.4±0.6	40.8±2.8	4.0±0.5	21.0±2.5	73.4±4.5	33.1±2.1
Adults	25	5.5±0.5	40.8±2.4	4.7±0.4	23.5±2.2	88.5±3.9	30.2±1.8
				Sex			
Significant		NS	NS	NS	***	**	*
Males	16	9±0.6	39.6±2.8	4.2±0.5	27.4±2.5	88.4±4.5	34.3±2.1
Females	25	6.0±0.5	42.0±2.4	4.6±0.4	17.0±2.2	73.5±3.9	29.0±1.8
Age × sex interaction		NS	NS	*	NS	NS	NS

*** P<0.001; ** P<0.01; * P<0.05 and NS: non significant.
CV: coefficient of variation.

Table 3 The effect of fixed factors on the fiber characteristics of hair Khorasan goats

Traits	N	Hair (%)	Down fibers (%)	Fiber diameter (micron)	CVF (%)
			Age		
Significant		NS	NS	NS	NS
Kids	17	89.9±3.6	9.60±3.7	16.5±1.0	17.9±1/9
Adults	17	89.0±3.8	11.0±3.8	16.4±1.1	18/1±2/0
			Sex		
Significant		NS	NS	NS	NS
Males	17	89.7±4.3	10.2±4.4	17.0±1.2	17.8±2.3
Females	17	89.3±2.9	10.5±2.9	15.9±0.8	18.2±1.5
Age × sex interaction		NS	NS	NS	NS

NS: non significant.

Table 4 The effects of fixed factors on mechanical characteristics of fleece in hair of Khorasan goats

Traits	N	Fleece weight (g)	Breaking load (gf)	Resistance (gf/text)	Elongation (%)
			Age		
Significant		*	NS	*	NS
Kids	16	205.5±15.8	7.3±0.6	8.0±0.9	11.3±2.0
Adults	25	196.2±15.8	7.5±0.5	10.5±1.5	15.4±1.5
			Sex		
Significant		*	*	NS	NS
Males	16	214±15.3	8.1±0.7	8.6±1.0	13.0±2.0
Females	25	186±4.15	6.7±0.5	9.9±0.7	13.7±1.4
Age × sex interaction		*	NS	NS	NS

* P<0.05 and NS: non significant.

In a research that has been done on the fibers of down fibers goats from New Zealand, it was reported that the age factor had an effect on fiber characteristics (Mc Gregor and Butler, 2008). Chekini *et al.* (2006) also reported that the lock length in different ages was significantly different and the fiber of young goats had a lower length than that of old goats. Eisazadeh *et al.* (2009) found that the diameter of hair was not affected by the type of the fiber but regarding this essay the age had a significant effect on the hair diameter. Taking into account fleece characteristics of hair goats

in Lorestan, there was no significant difference in diameter for different ages (Chekini *et al.* 2006; Eisazadeh *et al.* 2009). The effect of the age on percentage of down fibers and fiber diameter of Liaoning goats was significant, but the effect of this factor on the fleece quality of Australian and New Zealander goats was not significant (Mc Gregor and Butler, 2008). The fleece of goats from Abadeh of Iran and other indigenous goats of Fars province were influenced by the age (Negahdari *et al.* 2009). In hair goats of Iran, it is reported that age had a significant effect on fleece weight and down fibers diameter but it had no effect on the percentage of hair, hair diameter and length (Taherpour, 2004; Eisazadeh *et al.* 2009; Negahdari *et al.* 2009). According to the above information and the results of this assay, it is obvious that the age of animal in comparison to other factors causes the most relevant changes in quality of production, the thickness and the resistance of the fibers.

In the present study the male goats had higher diameter, coefficient variation of diameter and fleece weight than females. In hair Turkish goats there were considerable differences between two sexes, hence the production in male goats was reported to oscillate between 900 and 1000 g while in female goats was ranging between 400 and 500 g (Deger-Oral-Toply and Altinel, 2008).

The fleece weight of Iraqi males was 467.1 g in males and 344.9 g in females. The results of Salehi *et al.* (2000) indicated that the sex factor has a significant effect on the percentage of down fibers and hair but other characteristics of fleece were not influenced by the sex of the goats. The results reported by Eisazadeh *et al.* (2009) showed that sex had a significant effect only on the mean fleece weight and lock length but the mean hair diameter was not influenced by the sex. Otherwise, in Abadeh goats and hair goats of Fars province the sex factor had a significant effect on the fleece weight (Negahdari *et al.* 2009). According to these reports, it is clear that the most considerable effects of sex are related to the fleece weight and the quality of the fibers is less influenced by the differences between both sexes. In the present research, 26% of fleeces contained down fibers (Table 5) and the amount of down fibers in the fleece of female goats was more than in male goats, but the difference was not significant.

The diameter of down fibers had the mean of 16.4 ± 0.6 microns with the coefficient variation of 16%. Some studies showed that Lori hair goats and other goat breeds in Fars province had a very low amount of down fibers while 26% of fleeces obtained from the skin of killing Abade goats had down fibers by the amount of 3-45.5%. In the fleece of indigenous Pakistani goats that are often hair ones, the down fibers percentage was reported to be 13% (Pokharana *et al.* 1999). Regarding this issue, it can be described fleece of Khorasan goats as hair goats.

Table 5 Statistics of fleece characteristics in hair of Khorasan goats

Traits	N	Mean ±SE	CV (%)	Maxi-mum	Mini-mum
Hair (%)	17	88.7±2.1	10.0	69.5	99.0
Down fibers (%)	17	11.1±2.2	81.0	1.0	30.5
Down fibers diameter (microns)	17	16.4±0.6	16.0	13.2	22.5
CVF of down fibers (%)	17	18.3±1.1	25.0	11.6	30.4

CV: coefficient of variation.

Correlation between traits of hair and down fibers

Correlation coefficients between characteristics of hair fibers of Khorasan goats indicated that there is a correlation of +0.9 between the fiber and the lock length. Except the high correlation between mechanical characteristics of hair fibers, the biggest correlation was related to the length and diameter of the fibers with mechanical characteristics of fibers. Similar correlations were also reported between characteristics of hair fibers in Fars and Lorestan goats (Chekini *et al.* 2006; Eisazadeh *et al.* 2009). The correlation between the percentage of hair and the percentage of down fibers was significant (-0.9) but among other characteristics of down fibers there was no significant correlation.

CONCLUSION

According to the results, fleece weight from Khorasan kids and adult goats were in the range from 55 to 665 g, but generally the average amount of fleeces in these goats was lower than the fleece of other hair indigenous goats and some of foreign breeds. Regarding to the diameter of the fibers, they had better quality and could be classified as a qualified trade fibers. According to the maximum amount of down fibers the fleeces of these goats are placed in the hair fleeces and regarding to the minimum amount unless the down fibers containing fleeces should be packed separately. The fleece producing and the mean diameter were influenced by the age and sex of goats. So the separation of fibers especially among kids and adult goats could have a direct effect on the improvement of marketing in these fleeces.

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