

Morphometry of the Hairs in Different Regions of Skin in Adult Bakhtiari Sheep

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Abstract: In this study, all the hairs and their follicles characteristics of Iranian Bakhtiari sheep breed were investigated. A total of 24 apparently healthy Bakhtiari sheep (aged 3 years and more) were selected and categorized on the basis of sex (12 females and 12 males). Hair Samples were taken as small pieces from different regions of the skin, fixed and stained with Heamatoxylin and eosin. The following indices in each piece of skin were tested: total number of primary and secondary follicles per one mm², depth of primary and secondary follicles, width of primary and secondary hairs, width of primary and secondary follicles, the ratios of number, depth and width of secondary follicles to primary follicles. The one-way ANOVA and Duncan's Multiple Range test were used to analyze the data and detect of significant differences. No significant difference was observed among all the various regions of skin. Only the width of primary hairs and NS/P ratio were not affected by sex. Morphometrical measurements suggested that the Bakhtiari sheep may be characterized by an NS/P ratio of 0.31-1.15, primary follicle number of 2.83-9/mm², wool follicle number of 0.67-6.33/mm², primary follicle depth of 859.33-1670.83 μ and wool follicle depth of 298.33-588.33 -μ.

Key words: Bakhtiari · Hair · Morphometry · Sheep · Skin

INTRODUCTION

The skin has considerable economic value with regards to the leather, fur and wool industries [1]. Hair is an appendage of the skin that grows out of the hair follicle. The guard hair is produced by primary follicles whereas the secondary or cashmere is produced by secondary follicles [2]. The value of hair and wool produced by sheep is mainly determined by morphometry of hairs and follicles [3]. One of the major factor effects on wool characteristics in sheep is age. Quality and quantity characteristics of wool varied in different ages [4], which are related to the growth physiology of sheep [5]. In Iran, meat is the major product of sheep. Little milk is consumed but their fiber is used to make rugs and drugget. Almost all sheep breeds of Iran are indigenous and fat-tailed [6]. One major breed of fat-tailed sheep found in Charmahal va Bakhtiari province in Iran is Bakhtiari [4]. The local sheep are described as having coarse wool although no morphometric studies have

been carried out to determine their hairs. The objective of this study was to evaluate the morphometric fibers characteristics of distinct skin areas in different ages of adult Bakhtiari sheep.

MATERIALS AND METHODS

Twenty-four clinically healthy Iranian Bakhtiari sheep (aged 3 years and over) were selected according to their phenotypic features. The animals were categorized on the basis of sex (12 females and 12 males) in the abattoir of Shahrekord. Immediately after slaughtering, skins samples each of 3 cm² were obtained from the following eight regions on each sheep: 1-belly, 2-neck, 3-leg, 4-rump, 5- flank, 6- forearm, 7- shoulder and 8- hip. They were immediately fixed in 10% neutral buffered formalin solution for 24-48 hours and stained with Heamatoxylin and eosin [7]. By using ocular micrometer and lattice line graticule (5*5), the

following eleven indices were measured: number of primary (NP) and secondary follicles (NS) per one mm², depth of primary (HP) and secondary follicles (HS), the width of primary (WPH) and secondary hairs (WSH) and their follicles (WP and WS), the ratios of number (NS/P), depth (HS/P) and width of secondary follicles to primary follicles (WS/P). Data were analyzed by one-way ANOVA, using the SPSS statistic software version 18 for windows. Duncan's Multiple Range test was also used to detect significant differences (P<0.05).

RESULTS AND DISCUSSION

The means of primary and secondary follicles numbers were varied among various regions in Bakhtiari sheep (2.83-9 and 0.67-6.33, respectively). These findings were similar to those of Abbasi *et al.* [8] in Lori (3.22 and 7.63, respectively), Kocamis and Aslan [9] in Tuj breed (7.4-8.64 and 37.1-40.32, respectively), Kurtde and Asti [10] in German Black Head, Hampshire Down, Lincoln Longwool, White Karaman, Awassi and Konya Merino (26-38, 24-25, 20-38, 15-36, 13-16 and 44-72, respectively).

The numbers of primary and secondary follicles of flank skin in Bakhtiari sheep were 6.0 and 6.33 respectively (Table 1), while in other Iranian sheep breeds were 3.2-3.6 and 12.1-13.8 respectively [11]. In other sheep breeds such as Lori [8], Duben, Kotel, Stranja, Sakar and Central Rodopi [12], Omani native [13], were 3.13 and 7.3, 3.3 and 16.6, 2.9 and 17.1, 3.6 and 12.5, 3.2 and 12.9, 2.5 and 10.7, 22.9 and 12.8 respectively. In comparison of these results, indicated that the numbers of primary follicles of flank skin in Bakhtiari sheep were lesser than Omani native sheep, but is more than other breeds studied. Furthermore, the number of secondary follicles of this region in Bakhtiari sheep is less than all the breeds studied.

When the numbers of primary and secondary follicles of shoulder skin in Bakhtiari sheep (9 and 4.67, respectively) were compared with those in Lori (3.22 and 7.42, respectively), it was determined that the Bakhtiari sheep had more numbers of both follicles in shoulder skin than Lori sheep [8]. Genkovski and Gerchev [14] reported that in Tsigai ewes, the numbers of primary follicles of shoulder ranged from 3.64-4.15, which was very lesser than Bakhtiari ewes (8.67).

Table 1: Effect of body region and sex on number of primary follicles (NP), number of secondary follicles (NS), depth of primary follicles (HP), depth of secondary follicles (HS), width of primary follicles (WP) and width of secondary follicles (WS).

		Indices					
Region		NP	NS	HP	HS	WP	WS
Belly	M	4.33±1.15a	0.67±1.15	1183.3±627.80	400.67±225.39	160.0±34.64	154.0±24.25
	F	1.33±0.58a	0.67±0.58	633.33±85.05	345.0±5.0	203.33±66.58	32.33±22.50
	M±F	2.83±1.83	0.67±0.82	908.33±501.29	372.83±145.81	181.67±53.07	143.17±24.05
Neck	M	6.0±2.0	3.33±3.21	1310.0±334.51a	396.67±145.72a	143.67±5.69a	105.0±18.03
	F	7.0±2.65	8.67±1.15	2031.7±257.50a	780.0±91.65a	236.67±46.19a	120.0±26.46
	M±F	6.50±2.17	6.0±3.63	1670.83±477.0	588.33±236.51	190.17±58.83	112.50±21.85
Leg	M	9.33±2.52	3.33±3.21	766.67±45.09 b	261.67±7.64 b	156.67±15.27	116.67±16.07
	F	7.67±1.53	2.0±1.73	952.0±37.04 b	335.0±5.00 b	210.67±36.35	131.67±24.66
	M±F	8.50±2.07	2.67±2.42	859.33±108.01	298.33±40.58	183.67±38.68	124.17±20.35
Rump	M	7.0±1.0	4.0±3.46	1727.3±401.40	451.67±146.83	122.67±6.43 b	66.0±7.94
	F	4.33±2.08	0.54±0.40	1096.7±198.58	571.67±310.33	191.67±18.93b	95.0±35.0
	M±F	5.67±2.07	4.50±3.99	1412.0±446.70	511.67±226.86	157.17±39.85	80.50±27.70
Flank	M	6.67±2.89	7.33±2.08	1040.0±204.20	313.0±181.84	120.0±13.23	75.0±8.66a
	F	5.33±0.58	5.33±1.15	1210.0±245.15	545.0±265.56	140.67±18.88	135.0±25.98a
	M±F	6.0±2.0	6.33±1.86	1125.0±222.24	429.0±239.97	130.33±18.46	105.0±37.15
Forearm	M	5.0±2.64	3.0±1.0a	1451.70±283.30c	471.67±94.12	164.67±37.17	107.67±11.24
	F	4.67±2.08	0.67±0.58a	803.33±73.71c	333.33±30.55	173.33±20.82	120.0±36.05
	M±F	4.83±2.14	1.83±1.47	1127.50±400.47	402.50±98.27	169.0±27.36	113.83±24.82
Shoulder	M	9.33±2.08	3.67±2.52	1263.33±127.41	238.33±7.64	141.67±23.63	60.67±9.01
	F	8.67±1.53	5.67±1.15	1553.33±205.51	450.0±251.20	158.33±7.64	92.67±28.04
	M±F	9.0±1.67	4.67±2.07	1408.33±220.49	344.17±196.73	150.0±18.17	76.67±25.58
Hip	M	6.0±2.64	1.67±1.15	1535.0±299.04	215.0±63.17 b	161.67±20.21	56.67±7.64 b
	F	6.0±1.73	4.0±3.0	1152.33±158.95	586.67±86.22 b	182.33±59.21	121.67±37.53b
	M±F	6.0±2.00	2.83±2.40	1343.67±299.68	400.83±214.50	172.0±41.16	89.17±43.06

Mean±SD Note. F – Females; M – males; same small letters within a column differ significantly (P<0.05).

Table 2: Effect of body region and sex on follicle number ratio (NS/P), follicle depth ratio (HS/P), follicle width ratio (WS/P), width of primary hairs (WPH) and width of secondary hairs (WSH)

Region		Indices				
		NS/P	HS/P	WS/P	WPH	WSH
Belly	M	0.13±0.24	0.40±0.26	1.01±0.32	70.67±10.06	83.33±17.10a
	F	0.50±0.50	0.55±0.08	0.69±0.22	61.67±7.64	40.33±9.50a
	M±F	0.32±0.40	0.48±0.19	0.85±0.30	66.17±9.39	61.83±26.60
Neck	M	0.74±0.88	0.33±0.17	0.73±0.13	82.67±25.32	31.67±4.73b
	F	1.38±0.60	0.38±0.01	0.53±0.18	116.67±37.86	49.33±9.02b
	M±F	1.06±0.76	0.36±0.11	0.63±0.18	99.67±34.30	40.50±11.62
Leg	M	0.32±0.23	0.34±0.02	0.75±0.10	80.0±10.0	55.0±5.0
	F	0.30±0.32	0.35±0.02	0.63±0.13	83.0±14.73	66.67±11.55
	M±F	0.31±0.25	0.35±0.02	0.69±0.12	81.50±11.38	60.83±10.21
Rump	M	0.54±0.40	0.26±0.05	0.54±0.04	64.0±5.29	29.67±9.29
	F	1.18±0.94	0.55±0.35	0.52±0.24	96.67±20.82	53.33±15.27
	M±F	0.86±0.74	0.40±0.27	0.52±0.15	80.33±22.46	41.50±17.20
Flank	M	1.30±0.70	0.29±0.11	0.63±0.13a	66.0±8.72	37.33±2.52c
	F	1.00±0.20	0.46±0.23	0.95±0.08a	73.33±16.07	57.67±9.29c
	M±F	1.15±0.49	0.37±0.18	0.79±0.20	69.67±12.24	47.50±12.69
Forearm	M	0.75±0.43	0.33±0.05	0.67±0.12	73.33±14.05	67.67±13.65
	F	0.19±0.17	0.41±0.02	0.71±0.31	57.67±2.52	60.67±10.07
	M±F	0.47±0.42	0.37±0.06	0.69±0.21	65.50±12.45	64.17±11.39
Shoulder	M	0.45±0.38	0.19±0.02	0.44±0.10	81.0±39.15	38.0±6.08
	F	0.66±0.14	0.28±0.12	0.59±0.21	62.33±4.93	34.0±10.39
	M±F	0.56±0.28	0.23±0.09	0.51±0.17	71.67±26.97	36.0±7.92
Hip	M	0.42±0.50	0.15±0.06a	0.35±0.02	84.0±27.62	27.33±6.43
	F	0.70±0.62	0.51±0.01a	0.74±0.35	111.0±33.78	50.0±18.68
	M±F	0.56±0.53	0.33±0.20	0.54±0.31	97.50±31.31	38.67±17.61

Mean±SD Note. F – Females; M – males; same small letters within a column differ significantly (P<0.05).

The mean density of total follicles per mm² in various regions of skin was 0.67-9.0 in Bakhtiari sheep, while in Lori [15] and Merino and their hybrids [16] were 6 and 21.7 respectively.

The present study showed that in Bakhtiari sheep, the mean NS/P ratio was 0.31 to 1.15 (Table 2), which in other Iranian sheep breeds were 3.7- 3.5 [11]. In some other sheep breeds such as Awassi fat-tailed sheep [17], Omani native [13], Barki, Sannen, Togenburg, Lori [8] and Merino hybrids [16], were 4.2, 0.6, 2.4, 3.9, 2.4, 2.26 and 4.8 ratios respectively. The highest NS/P was found in Merino sheep [18], which mounts to 16.5 and 4.2, respectively.

In comparison of the NS/P ratio of flank skin in Bakhtiari ewes (1.0) with those of Raichev and Khristova (12) in Duben (5.2), Kotel (4.8), Stranja (4.2), Sakar (3.9) and Central Rodopi (4.2), it was seen that the NS/P ratio was lower in Bakhtiari ewes.

When the NS/P ratio of shoulder skin in Bakhtiari ewes (0.66) were compared with those in Tsigai ewes (1.36-1.47), it was found that the NS/P ratio in shoulder skin of Bakhtiari sheep was lesser than Tsigai sheep [14].

There are some indications that the quality of wool depends up on NS/P ratio as higher ratio refers to better quality for the wool [19] and this ratio is hereditary but it is influenced by diet considerable [18]. This lower ratio revealed that the wool quality in Bakhtiari sheep is not satisfactory when compared to other breeds and this breed such as other breeds raised in different parts of Iran characterized by a low NS/P ratio and could be classed as carpet wool breeds [11].

In Bakhtiari skin, the least depth of primary (859.33 μ) and secondary follicles (298.33 μ) was recorded in leg region and the maximum depth of 1670.83 μ and 588.33 μ was recorded in neck region respectively. Mir Shabir *et al.* [20] stated that in Madras red sheep, the minimum and maximum depth of primary follicles (784.33 and 1935.0 μ, respectively) was in neck dorsal and ventral region respectively.

The depth of primary and secondary follicles in shoulder skin in Bakhtiari ewes were respectively, 1553.33 μ and 450.0 μ, but in Tsigai ewes were ranged from 1695.4- to 1735.8 μ and 1095.0 to 1142.0 μ respectively [14].

The width of primary and secondary follicles in shoulder skin in Bakhtiari ewes were 158.33 and 92.67 μ respectively, but in Tsigai ewes were ranged from 104.2-119.4 μ and 74.7-81.0 μ respectively [14]. Also, the width of primary and secondary follicles in flank skin in Bakhtiari ewes were 140.67 and 135.0 μ respectively, but in Duben, Kotel, Stranja, Sakar and Central Rodopi ewes were 113.4 and 86.4 μ , 140.9 and 79.4 μ , 145.6 and 76.9 μ , 148.6 and 82.7 μ and 134.6 and 80.6 μ respectively [12].

The width of primary or guard hairs in Bakhtiari sheep ranged from 65.50-99.67 μ , whereas the secondary or wool hairs possessed diameters ranging from 36.0-64.17 μ . Mahgoub μ . [13] reported fiber diameter of flank skin was 45.9 μ in Omani native ewes, but in the present study was ranged from 57.67-73.33 μ . Diameters of hairs between species can vary from 10-250 μ and are influenced by the metabolic and nutritional state of the animal [21].

Although no significant difference was observed in all the indices among all various skin regions of the Bakhtiari sheep and also no significant influence of sex on the width of primary hairs and NS/P ratio ($P < 0.05$), but the other indices were affected by sex.

In the present study, the depth of primary follicles and the number of secondary follicles in the forearm skin and the number of primary follicles in the belly skin in males were only more than females. The other indices in females were higher.

Significant sex-based differences were also reported in Lori [8], Merino [16], Madras red [20], Awassi fat-tailed sheep [17]. Yeruham μ . [22] concluded that the gender-related changes of skin were attributed to endogenous androgen stimulation at puberty.

CONCLUSION

It is concluded that the skin in Bakhtiari sheep characterized by a low NS/P ratio and can be classified as carpet wool breeds. There were no significant effects of sex on quality of wool.

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