



Received: 27th Sept-2012

Revised: 30th Sept-2012

Accepted: 04th Oct-2012

Research article

A MORPHOMETRIC STUDY ON DIFFERENT REGIONS OF THE SKIN IN LORI-BAKHTIARI SHEEP AT DIFFERENT AGES

Behzad Mobini,^{1*} and Kaveh Shirani Faradonbeh²

^{1*}Corresponding author: Department of Basic Sciences, College of Veterinary Medicine, Islamic Azad University, Shahrekord branch, P.O.Box 166, Shahrekord, Iran.

Phone: +98-311-7754770; Fax: +98-381-3361045; Email: dr.mobini@iaushk.ac.ir

²Under Graduated Student of Veterinary Medicine, College of Veterinary Medicine, Islamic Azad University, Shahrekord branch, Shahrekord, Iran.

ABSTRACT: In this study, 24 Lori-Bakhtiari sheep were selected in the abattoir of Shahrekord. The animals divided into four age groups: 1-10 days, 5-8 months, 1-2 years and 3 years and more. In each age group, six animals (3 each sex) were used. Skin samples were taken from different areas, fixed and stained with haematoxylin and eosin. Morphometrical studies on these sections were carried out using light microscope and ocular micrometer respectively. Thickness of skin, epidermis and dermis, were measured in all the regions of skin in both sexes. The one-way ANOVA and Duncan's Multiple Range test were used to analyze the data and detect of significant differences. The total skin thickness of different regions in neonate, young, young adult and old adult of Lori-Bakhtiari sheep ranged from 1197.81-1912.92, 1028.13-1861.90, 1712.08-2932.62, and 1585.24-2717.45 μ respectively. It was found that the thickness of total skin, epidermis, papillary layer and reticular layer of dermis varied among all the regions and was affected significantly by age and sex ($P < 0.05$).

Key words: age, Lori-Bakhtiari sheep, morphometric, sex, skin

INTRODUCTION

Skin has considerable economic value with regards to the leather, fur and wool industries [1]. Hairs or wool fibers produce from hair follicles and divided into two groups as primary and secondary hairs [2, 3]. The sheep population in Iran is 50 million, comprising 26 genetic groups [4]. One of the main Iranian fat-tailed and native breeds is Lori-

Bakhtiari which found in Charmahal va Bakhtiari province where sheep production contributes significantly to the agricultural economy [5]. Quality and quantity characteristics of wool varied in different ages, which are related to the growth physiology of sheep [5]. The value of hair and wool produced by sheep is mainly determined by histomorphometry of hairs and follicles [6]. In the available literature, there is a lack of data characterizing the morphometric properties of the hair follicles in Lori-Bakhtiari sheep. The objective of this study was therefore to describe these properties in Lori-Bakhtiari breed and evaluate their variations among different ages and areas of skin.

MATERIALS AND METHODS

Twenty-four Lori-Bakhtiari sheep were selected according to their phenotypic features in the abattoir of Shahrekord and divided into four age groups: 1-10 days (neonate), 5-8 months (young), 1-2 years (young adult) and 3 years and more (old adult). In each age group, six animals (3 each sex) were used. Samples of skins each of 3 cm² were taken from the following eight regions on each sheep: belly, neck, leg, rump, flank, forearm, shoulder and hip. They were fixed in 10 percent neutral buffered formaldehyde. Tissues were stained with haematoxylin and eosin. Morphometrical studies on these sections were carried out using respectively. By using light microscope and ocular micrometer, thickness of skin, epidermis and dermis were measured in all the four age groups and in all the regions of skin. Data were finally analyzed by one-way ANOVA, using the SPSS statistic software version 18. Duncan's Multiple Range test was also used to detect significant differences ($P < 0.05$).

RESULTS

The only significant difference in thickness of papillary layer of dermis, between males and females was observed in the belly skin that in females were thicker than males in the sheep aged 1-10 days. In neonatal sheep, the only significant sex-related difference in reticular layer thickness was observed in the rump skin that in females were thicker than males (Table 1).

The thickness of the skin varied among the regions and different age groups studied. The maximum thickness of skin (1912.92 and 2717.45 μ) was recorded in neonates and old adult sheep respectively on the neck followed by 1861.90 μ in young on the leg and 2932.62 μ in young adult sheep on flank region. The minimum thickness of skin (1197.81 and 1712.08 μ) was recorded in neonates and young adult sheep respectively on the forearm followed by 1028.13 μ in young on the shoulder and 1585.24 μ in old adult sheep on leg region. The maximum thickness of epidermis (50.71 and 65.71 μ) was recorded in young and young adult sheep respectively on the rump followed by 33.91 μ in neonatal sheep on the leg and 80.36 μ in old adult sheep on forearm region. The minimum thickness of epidermis (20.77 μ) was recorded in neonates on the flank followed by 23.96 μ in young on the shoulder and 30.42 μ in young adult sheep on neck and 41.17 μ in old adult sheep on rump region.

The maximum thickness of papillary layer of dermis (1104.17 and 1779.17 μ) was recorded in neonatal and old adult sheep respectively on the neck followed by 900 μ in young sheep on the leg and 1491.67 μ in young adult sheep on shoulder region. The minimum thickness of papillary layer of dermis (778.57 and 716.67 μ) was recorded in neonatal and old adult sheep respectively on the leg followed by 416.67 μ in young sheep on the belly and 920.83 μ in young adult sheep on forearm region.

The thickness of reticular layer of dermis also varied among the regions and different age groups studied. The maximum thickness of reticular layer of dermis (775.0 and 1145.83 μ) was recorded in neonatal and young sheep respectively on the neck followed by 1495.83 μ in young adult sheep on the flank and 1025 μ in old adult sheep on shoulder region. The minimum thickness of reticular layer of dermis (312.5 and 660.71 μ) was recorded in neonatal and young adult sheep respectively on the belly followed by 341.67 μ in young sheep on the forearm and 812.50 μ in old adult sheep on leg region.

In neonatal sheep, the thickness of epidermis in forearm and hip skin showed significant differences between males and females, so that the maximum and minimum thickness of epidermis (46.67 and 12.5 μ) was found in forearm of males and forearm of female sheep respectively. In young sheep, the thickness of epidermis in the belly, leg, forearm and hip skin were affected by sex, and in males were thicker than females. In the 5-8 months age group, sex related differences in the thickness of papillary layer of dermis were observed for the rump and hip skin. This layer in males was thicker than females. The only significant sex- based difference for the reticular layer thickness in the sheep aged 5-8 months was observed in the rump skin that in females were thicker than males (Table 2).

Table 1 Thickness of skin layers (μ) at different regions of 1-10 days ages of Lori-Bakhtiari sheep (mean \pm SD).

Region		Epidermis	Dermis	
			Papillary layer	Reticular layer
Belly	M	26.07 \pm 11.89	766.67 \pm 38.19 a	233.33 \pm 62.91
	F	28.21 \pm 6.07	966.67 \pm 137.69 a	391.67 \pm 212.62
Neck	M	35.71 \pm 17.18	950.00 \pm 139.19	808.33 \pm 187.64
	F	31.00 \pm 3.79	1258.33 \pm 80.36	741.67 \pm 101.04
Leg	M	36.67 \pm 18.03	837.50 \pm 228.67	418.75 \pm 158.61
	F	30.36 \pm 3.93	700.00 \pm 90.14	583.33 \pm 262.60
Rump	M	30.83 \pm 16.49	883.33 \pm 200.52	300.00 \pm 108.97 a
	F	25.50 \pm 5.97	1300.00 \pm 390.51	608.33 \pm 76.38 a
Flank	M	22.50 \pm 6.12	1125.00 \pm 175.00	641.67 \pm 150.69
	F	18.00 \pm 6.94	900.00 \pm 217.94	525.00 \pm 152.07
Forearm	M	46.67 \pm 17.86 a	741.67 \pm 80.36	400.00 \pm 241.09
	F	12.50 \pm 3.95 a	866.67 \pm 80.36	325.00 \pm 66.14
Shoulder	M	33.33 \pm 12.42	800.00 \pm 278.39	700.00 \pm 501.87
	F	24.00 \pm 7.20	783.33 \pm 123.32	608.33 \pm 224.07
Hip	M	40.83 \pm 12.42 b	741.67 \pm 94.65	608.33 \pm 374.44
	F	14.00 \pm 4.87 b	858.33 \pm 52.04	291.67 \pm 38.19

F-females; M-males; Same small letters within a column differ significantly ($P < 0.05$).

In the 1-2 years sheep, with the exception of the leg and shoulder, the thickness of epidermis in the other skin regions were more in females than males. In the sheep aged 1-2 years, the males had significant thicker of papillary layer of dermis in all the skin regions than females. In young adult sheep, the thickness of reticular layer of dermis in the belly, neck and forearm skin were also affected by sex, and in males were thicker than females (Table 3). In the old adult sheep, males had thicker epidermis in forearm and hip skin than females, whereas the thickness of epidermis in the leg skin was more in females than males. In the 3 and more years sheep, females had thicker papillary layer of dermis in neck, flank, shoulder and hip skin than females whereas, it was more in males than females for the forearm skin. The only significant sex- based difference for the reticular layer thickness in the sheep aged 3 and more years was observed in the flank skin that in males were thicker than females (Table 4).

Table 2 Thickness of skin layers (μ) at different regions of 5-8 months ages of Lori-Bakhtiari sheep (mean \pm SD)

Region	Sex	Epidermis	Dermis	
			Papillary layer	Reticular layer
Belly	M	53.75 \pm 15.24 a	491.67 \pm 301.39	1108.33 \pm 38.19
	F	35.00 \pm 11.73 a	341.67 \pm 62.91	700.00 \pm 338.19
Neck	M	26.25 \pm 11.59	591.67 \pm 208.17	991.67 \pm 251.66
	F	27.50 \pm 6.92	666.67 \pm 224.07	1300.00 \pm 238.48
Leg	M	50.00 \pm 13.95 b	825.00 \pm 246.22	1016.67 \pm 128.29
	F	29.17 \pm 11.80 b	975.00 \pm 163.94	825.00 \pm 288.31
Rump	M	37.08 \pm 9.80	925.00 \pm 66.14 a	508.33 \pm 94.65 a
	F	60.94 \pm 26.39	550.00 \pm 43.30 a	841.67 \pm 128.29 a
Flank	M	26.67 \pm 3.03	683.33 \pm 170.17	441.67 \pm 38.19
	F	22.50 \pm 4.18	666.67 \pm 80.36	625.00 \pm 139.19
Forearm	M	48.75 \pm 13.30 c	883.33 \pm 184.28	333.33 \pm 28.87
	F	27.14 \pm 9.51 c	633.33 \pm 57.73	350.00 \pm 43.30
Shoulder	M	27.50 \pm 19.75	600.00 \pm 90.14	408.33 \pm 128.29
	F	20.42 \pm 5.34	608.33 \pm 142.16	391.67 \pm 76.38
Hip	M	41.25 \pm 13.67 d	1050.00 \pm 222.20 b	725.00 \pm 50.00
	F	22.50 \pm 3.06 d	325.00 \pm 129.90 b	583.33 \pm 212.62

F-females; M-males; Same small letters within a column differ significantly ($P < 0.05$).

Table 3 Thickness of skin layers (μ) at different regions of 1-2 years ages of Lori-Bakhtiari sheep (mean \pm SD)

Region	Sex	Epidermis	Dermis	
			Papillary layer	Reticular layer
Belly	M	22.50 \pm 4.68 a	1200.00 \pm 360.55	1083.33 \pm 137.69 a
	F	63.21 \pm 21.20 a	1100.00 \pm 170.78	343.75 \pm 106.80 a
Neck	M	22.92 \pm 5.10 b	1225.00 \pm 173.20	1266.67 \pm 52.04 b
	F	37.92 \pm 9.28 b	1233.33 \pm 101.04	858.33 \pm 123.32 b
Leg	M	56.50 \pm 6.75 c	1500.00 \pm 114.56 a	833.33 \pm 274.24
	F	33.21 \pm 8.38 c	1125.00 \pm 84.16 a	706.25 \pm 134.44
Rump	M	47.08 \pm 10.89 d	1866.67 \pm 339.42 b	1033.33 \pm 284.31
	F	79.69 \pm 31.12 d	1000.00 \pm 216.51 b	800.00 \pm 125.00
Flank	M	35.00 \pm 7.42 e	1491.67 \pm 212.62	1766.67 \pm 341.26
	F	60.00 \pm 15.47 e	1283.33 \pm 80.36	1225.00 \pm 90.14
Forearm	M	35.42 \pm 12.19	1250.00 \pm 156.12 c	1066.67 \pm 194.19 c
	F	38.75 \pm 17.08	591.67 \pm 118.14 c	441.67 \pm 14.43 c
Shoulder	M	63.33 \pm 16.56 f	2050.00 \pm 478.93 d	1000.00 \pm 229.13
	F	35.42 \pm 15.44 f	933.33 \pm 262.60 d	816.67 \pm 200.52
Hip	M	18.75 \pm 8.18 g	1283.33 \pm 62.91 e	958.33 \pm 314.58
	F	41.79 \pm 17.30 g	766.67 \pm 276.51 e	725.00 \pm 175.00

F-females; M-males; Same small letters within a column differ significantly ($P < 0.05$).

Table 4 Thickness of skin layers (μ) at different regions of 3 years and more ages of Lori-Bakhtiari sheep (mean \pm SD)

Region	Sex	Epidermis			Dermis	
				Papillary layer	Reticular layer	
Belly	M	76.88 \pm 83.83		916.67 \pm 118.14	891.67 \pm 52.04	
	F	49.06 \pm 18.89		1066.67 \pm 462.56	741.67 \pm 160.73	
Neck	M	59.06 \pm 22.64		1458.33 \pm 280.99 a	875.00 \pm 486.70	
	F	42.50 \pm 7.44		2100.00 \pm 5.00 a	900.00 \pm 5.00	
Leg	M	45.71 \pm 15.86 a		575.00 \pm 43.30	741.67 \pm 146.49	
	F	66.43 \pm 18.48 a		858.33 \pm 251.66	883.33 \pm 224.07	
Rump	M	35.00 \pm 12.89		1891.67 \pm 137.69	791.67 \pm 267.32	
	F	48.21 \pm 19.46		1091.67 \pm 600.17	925.00 \pm 694.62	
Flank	M	40.83 \pm 4.92		575.00 \pm 5.00 b	1248.33 \pm 7.64 a	
	F	69.17 \pm 32.74		1358.33 \pm 350.30 b	633.33 \pm 87.80 a	
Forearm	M	96.43 \pm 35.53 b		1983.33 \pm 242.81 c	875.00 \pm 363.15	
	F	64.29 \pm 10.58 b		1083.33 \pm 226.84 c	1066.67 \pm 142.16	
Shoulder	M	63.93 \pm 15.06		725.00 \pm 5.00 d	950.00 \pm 5.00	
	F	51.07 \pm 26.17		1475.00 \pm 139.19 d	1100.00 \pm 278.39	
Hip	M	57.50 \pm 16.27 c		1083.33 \pm 194.19 e	1058.33 \pm 128.29	
	F	34.69 \pm 22.14 c		2191.67 \pm 123.32 e	766.67 \pm 202.07	

F-females; M-males; Same small letters within a column differ significantly ($P < 0.05$).

DISCUSSION

The thickness of the skin was varied among all the regions and different age groups studied. This finding is in agreement with the results of previous studies [7, 8]. In neonatal, young, young adult and old adult sheep, the total skin thickness ranged from 1197.81 to 1912.92 μ , 1028.13 to 1861.9 μ , 1712.08 to 2932.62 μ , and 1585.24 to 2717.45 μ , respectively. Genkovski and Gerchev [7] reported that in Tsigai ewes, the total skin thickness ranged from 2703.5 to 2994.7 μ . Abbasi *et al.* [9] observed that the total skin thickness was 2400 μ in Lori sheep. The total skin thickness in native and hybrid of Merino sheep was 2897.8 μ to 3507.2 μ [3]. The total thickness of flank skin of some indigenous types of Bulgarian sheep aged 2 years was averaged 2269, 2308, 1971, 2007 and 1748 μ , respectively [10]. The thickness of skin had increased as age advanced as reported by Mir Shabir *et al.* [8] in madras red sheep, Fayez *et al.* [11] in Awassi fat-tailed sheep and Saxena *et al.* [12] in cattle. Thickness of skin increased rapidly from young age to adult than from neonatal age to young and from young adult to old adult age, whereas thickness of skin in madras sheep increased rapidly from neonatal age to young than from young to adult age [8]. The thickness of epidermis was varied in different regions and in all the four age groups. This finding is in agreement with the results of previous studies [7, 8, 9, 13, 14, 15, 16]. The maximum thickness of the epidermis was found in the leg (33.91 μ) at 1-10 days, rump (50.71 μ) at 5-8 months, rump (65.71 μ) at 1-2 years, and forearm (80.36 μ) at 3 and more years of age, in Lori-Bakhtiari sheep. The minimum thickness of the epidermis in neonatal, young, young adult and old adult sheep was observed in the flank (20.77 μ), shoulder (23.96 μ), neck (30.42 μ), and rump (41.17 μ), respectively. The total skin thickness of Tsigai sheep was between 2703.18 μ and 2994.7 μ [7]. Abbasi *et al.* [9] observed that the thickness of epidermis of different regions of Lori sheep was between 8 mm and 45 mm with an average of 17.54 mm. Britt *et al.* [14] stated that in Australian Merino sheep, the thickness of epidermis of skin of thoracolumbar region was 24.9 mm. The epidermis thickness of the back region in sheep breeds fetuses were 17.74, 40.72 and 23.28 μ [13]. The thickness of the epidermis of different regions of German black head, Hampshire Down, Lincoln longwool, white Karaman, Awassi and Konya Merino was 15-25, 18-25, 15-25, 22-44, 20-38, and 18-24 μ respectively [16]. Mir Shabir *et al.* [8] stated that in madras red sheep, the thickest epidermis was found on the neck region.

When the percentages of epidermis in old adult Lori-Bakhtiari sheep (1.72 to 3.54 %) were compared with those in adult Tsigai ewes (0.65 to 0.71 %), it was determined that the number of cell layers constituted this layer in Lori-Bakhtiari sheep was more than Tsigai ewes [7].

The thickness of dermis was varied in different regions and in all the four age groups. From neonatal to adult age group sheep, thickness of both papillary and reticular layers of the dermis was found to be increased in all the regions in the present study, which correlates to the findings of Mir Shabir *et al.* [8] in madras red sheep. In the present study, the maximum thickness of dermis was found in 1-10 days and 3 years and more ages in the neck (1879.17 and 2666.67 μ respectively), in young age in the leg (1820.83 μ) and in young adult sheep in the flank region (2883.33 μ). The average initial thickness of dermis in sheep breeds fetuses was 143.55 and 1770 μ [13]. The average thickness of the dermis in the neck, flank and hip regions was 2250, 2400, 2250 μ respectively in German blackhead and Hampshire Down, 2500, 2500, 2550 μ in Lincoln longwool, 2750, 2700, 2650 μ in white Karaman, 3300, 3250, 2700 μ in Awassi, and 2500, 2500, 2450 μ in Konya Merino [16]. The thickness of papillary layer of dermis was from 920.83 -1491.67 μ for young adult sheep to 716.67- 1779.17 μ for old adult Lori-Bakhtiari sheep. Raichev and Khristova [10] observed that in Duben, Kotel, Stranja, Sakar and Central Rodopi ewes, the thickness of papillary layer of flank skin averaged 1579, 1670, 1500, 1494 and 1229 μ respectively. The percentages of papillary layer were found to be higher in Tsigai ewes (67.24-68.77 %) when compared to the old adult sheep (45.21 to 65.47 %) in the present study. on the other hand, the percentages of reticular layer in old adult Lori-Bakhtiari sheep (32.66-51.25 %) were more than Tsigai ewes (30.49-32.08 %) that indicated the dermis of Lori-Bakhtiari sheep skin consisted of more reticular layer and less papillary layer [7]. Butler [15] also noted that variation may exist between sheep in the depth and relative proportions of epidermis, reticular layer and papillary layer of the dermis. These differences may influence wool production and the environmental responsiveness and fiber diameter profiles of sheep.

REFERENCES

- [1] Konig HE, Liebich HG. 2004. Veterinary anatomy of domestic mammals. Schatter, New York, pp. 585-635.
- [2] Kurtde N. 2002. Investigation on the skin structure of Lincoln longwool x Konya merino cross-bred (f1 and b1) sheep. Turkish Journal of Veterinary Animal Science 26, 709-714.
- [3] Ozfiliz N, Balıkcı M, Erdost H, Zik B. 2002. Histological and morphometric features of the skin of native and hybrid (F1) sheep. Turkish Journal of Veterinary Animal Science 26, 429-438.
- [4] Kiyanzad MR, Panandam JM, Emamjomeh Kashan N, Jalan ZA, Dahlan I. 2003. Reproductive performance of three Iranian sheep breeds. Asian-Australian Journal of Animal Science 16, 11-14.
- [5] Mobini B. 2012. An Assessment of Fibers in Various Areas of Skin in Male and Female Bakhtiari Breed Lambs. Journal of Veterinary Advances 2, 273-278.
- [6] McDonald BJ, Hoey WA, Hopkins PS. 1987. Cyclical fleece growth in cashmere goats. Australian Journal of Agricultural Research 38, 597-609.
- [7] Genkovski D, Gerchev G. 2007. Study of the skin histological structure in ewes from Staroplaninska and Thoroughbred Tsigai. Biotechnology in Animal Husbandry 23, 191-197.
- [8] Mir Shabir A, Sathyamoorthy OR, Ramesh G, Balachandran C. 2011. Micrometrical studies on the skin of madras red sheep (*Ovis Aries*) in different age groups, Tamilnadu Journal of Veterinary and Animal Sciences 7, 23-28.
- [9] Abbasi M, Gharzi A, Karimi H, Khosravinia H. 2008. Effects of sex on histological characteristics of various areas of skin in an Iranian native breed of sheep. Journal of Animal and Veterinary Advances 7, 1503-1505.
- [10] Raichev S, Khristova G. 1990. Microscopical morphology of the skin of some indigenous types of sheep in Bulgaria. Zhivotnovdni Nauki 27, 67-74.
- [11] Fayez I, Marai M, Taha AH. 1976. Wool follicle characteristics in the Awassi fat-tailed sheep. Acta Anatomica 96, 55-69.
- [12] Saxena SK, Malik MR, Parekh HKB. 1994. Histological character of skin in crossbred cattle. Indian Journal of Veterinary Anatomy 6, 8-11.
- [13] Aktas A, Dagloglu S. 2009. Examination of structural features of skin in sheep breeds fetuses with histological methods. Veterinary Journal of Kafkas University 15, 391-396.
- [14] Britt AG, Cotton CL, Kellett BH, Pitman IH, Trask JA. 1985. Structure of the epidermis of Australian Merino sheep over a 12- month period. Australian Journal of Biological Sciences 38, 165-174.

- [15] Butler LG. 1991. Potential application of new technologies in research and as indirect selection criteria for wool production efficiency or quality. In: Hynd PI (eds), *Wool Biology*, pp. 106-110. Australian Wool Corporation.
- [16] Kurtdede N, Asti RN. 1999. The investigation on the skin structure of German Black Head, Hampshire Down, Lincoln Longwool, White Karaman, Awassi and Konya Merino, *Veterinary Journal of Ankara University* 46, 219-230.