Bulgarian Journal of Veterinary Medicine (2013), **16**, No 1, 1–6

STUDIES ON THE DENSITY OF VARIOUS DERMAL STRUCTURES IN ADULT RAMS AND EWES

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Summary

Mobini, B., 2013. Studies on the density of various dermal structures in adult rams and ewes. *Bulg. J. Vet. Med.*, **16**, No 1, 1–6.

The study was carried out to detect the densities of different dermal structures in 24 adult healthy Bakhtiari sheep, aged 3 years and more. Small pieces from different regions of the skin were taken, fixed and stained with haematoxylin and eosin. The determinations of densities of structures were carried out using lattice line graticule (5*5) and light microscope. The one-way ANOVA and Duncan's multiple range test were used to analyse the data and detect significant differences. The densities of different histological structures varied between sexes and among the different body regions. Except for the hair follicle and connective tissue, the densities of other tissue structures were significantly affected by sex. No significant difference was observed in densities of blood vessels, sebaceous glands and arrector pili muscles, but the other parameters studied differed significantly among the regions. Sex-related differences were found in the densities of all tissue structures among all the regions except for the belly and hip skin.

Key words: Bakhtiari, density, dermis, ewe, ram

INTRODUCTION

Sheep are an important source of animal protein and wool worldwide (Mahgoub *et al.,* 2010). Iran possesses 20 breeds of sheep. More than 96% of Iranian sheep are fat-tailed (Kiyanzad *et al.,* 2003). One of the main Iranian fat-tailed native breeds is Bakhtiari, which is encountered in West and Southwest regions of the country especially in Charmahal va Bakhtiari province where sheep production contributes significantly to the economy.

Skin is the largest organ of the body consisting of an epidermis and a dermis (Dellmann, 1993). Sheep skin is of considerable economic value to the leather, fur and wool industries (Konig & Liebich, 2004). The epidermis that covers the outer surface of the skin is lined with stratified squamous keratinised epithelium (Banks, 1985; Dağlıoğlu & Bayramlar, 1988; Dellman, 1993). The dermis is a connective tissue that supports the epidermis. Histologically, it consists of two sublayers – papillary and reticular (Kurtdede, 2002). The sebaceous and sweat glands which derive from interactions of the epidermis and dermis within the skin (Widelitz *et al.,* 1997) are located close to hair follicles in the papillary layer (Kurtdede, 2002; Özfiliz *et al.,* 2002). Hairs or wool fibres produced from hair follicles are divided into two groups: primary and secondary hairs (Kurtdede, 2002; Özfiliz *et al.,* 2002). The quality and quantity

characteristics of wool vary at different ages, and are related to the growth physiology of sheep (Yarahmadi *et al.,* 2008).

The measurements of dermal structures in sheep may offer a number of potential benefits for sheep producers in terms of wool growth and body condition monitoring. The value of hair and wool produced by sheep is mainly determined by morphometry of skin and dermal structures such as hairs and follicles (McDonald *et al.,* 1987). Also, there is clear evidence of a strong relationship between the skin structures and wool yellowing in Merino and Romney sheep (Sumner & Craven, 2005). One of the main skin morphometric studies is the evaluation of the densities of various dermal structures which have not been carried out in the most breeds especially in Bakhtiari sheep.

Therefore, this study was designed to determine the densities of different histological structures of the dermis in various skin regions of Iranian Bakhtiari sheep.

MATERIALS AND METHODS

Twelve clinically healthy Iranian Bakhtiari ewes and twelve rams (3 years and more) were used to determine the densities of various dermal structures of skin. Sheep were selected according to their phenotypic features. Samples of skins each of 3 cm^2 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. Skin samples were fixed in neutral buffered formalin solution for 24 to 48 h, cleared, and embedded in paraffin wax. Transverse sections (6 μm thick) were cut parallel to the surface of the skin at mid-sebaceous gland level and stained with haematoxylin and eosin (Kiernan, 1999). By using lattice line graticule (5*5), the densities of the following six parameters were measured per one mm^2: total hair follicles (F), sweat glands (Sw), sebaceous glands (Se), arrector pili muscles (Ar), blood vessels (Bv) and connective tissues (Ct).

Data were analysed by one-way ANOVA and Duncan's multiple range test to detect significant differences ($P<0.05$), using the SPSS v. 18 statistic software.

RESULTS

The densities of studied different histological structures varied between sexes and among the various regions of skin. There were not significant differences in the densities of blood vessels, sebaceous glands and arrector pili muscles among the various regions studied ($P<0.05$) (Table 1).

The highest and lowest hair follicle densities were found respectively in rump (11.80±8.13) and belly (4.17±2.77) skin samples ($P<0.05$). Sex-related differences were not observed for this parameter.

The mean total follicles density per mm^2 in the various skin regions ranged between 4.17±2.77 and 11.80±8.13. In this study, the mean follicle density in various regions of skin in rams varied between 4.63–16.66 and in ewes: between 2.32–9.72.

The maximum and minimum sweat gland density was recorded in belly (4.40±2.22) and rump skin (1.16±1.05), respectively ($P<0.05$). There was evidence for sex-related differences in sweat gland densities in leg and forearm regions with higher density in ewes than in rams ($P<0.05$).

The sebaceous gland area per unit length of flank skin in Bakhtiari ewes was 1.39±1.39. Sexual dimorphism was observed in the density of sebaceous glands

Table 1. Mean densities of total follicles (F), sweat glands (Sw), sebaceous glands (Se), arrector pili muscles (Ar), blood vessels (Bv) and connective tissue (Ct) per one mm^2 skin area in different body regions of adult male (M; n=12) and female (F; n=12) Bakhtiari sheep. Data are presented as mean ± SD

Region		Structures					
		F	Sw	Se	Ar	Bv	Ct
Belly	M	6.02±2.89	4.63±2.12	0.93±0.80	2.32±0.80	0.46±0.80	18.98±4.46
	F	2.32±0.80	4.17±2.77	0.00±0.0	0.93±0.80	0.46±0.80	25.46±2.89
	M+F	4.17±2.77^{A}	4.40±2.22^{A}	0.46±0.72	1.62±1.05	0.46±0.72	22.22±4.89^{AB}
Neck	M	7.87±1.60	0.46±0.80	1.39±1.39	1.39±1.39	2.32±0.80*	19.90±0.80
	F	8.79±3.21	2.78±1.39	1.39±1.39	1.39±1.39	0.00±0.0	18.98±1.60
	M+F	8.33±2.32^{AB}	1.62±1.62^{AB}	1.39±1.24	1.39±1.24	1.16±1.37	19.44±1.24^{A}
Leg	M	4.63±1.60	0.46±0.80*	0.00±0.0	0.46±0.80	1.85±0.80*	25.93±0.80
	F	5.56±2.40	2.78±0.0	0.46±0.80	0.93±0.80	0.00±0.0	23.61±2.78
	M+F	5.09±1.89^{A}	1.62±1.37A^{B}	0.23±0.57	0.69±0.76	0.93±1.13	24.77±2.23^{B}
Rump	M	16.66±9.62	1.85±0.80	1.85±0.80	0.00±0.0*	2.78±1.39*	19.44±1.39
	F	6.94±1.39	0.46±0.80	0.93±1.60	3.24±1.60	0.00±0.0	21.76±1.60
	M+F	11.80±8.13^{B}	1.16±1.05^{B}	1.39±1.24	1.62±2.05	1.39±1.76	20.60±1.85^{A}
Flank	M	6.94±1.39	2.78±2.41	1.85±1.60	0.46±0.80	1.85±0.80*	19.44±2.41
	F	5.55±1.38	4.17±1.38	1.39±1.39	1.85±0.80	0.00±0.00	20.37±2.12
	M+F	6.25±1.45^{A}	3.47±1.91^{AB}	1.62±1.37	1.16±1.05	0.93±1.13	19.90±2.09^{A}
Forearm	M	6.48±5.26	1.39±0.0*	2.78±1.39*	1.39±1.39	1.39±1.39	119.90±1.60
	F	5.55±1.38	5.55±2.40	0.00±0.0	1.85±0.80	0.00±0.0	20.37±4.01
	M+F	6.02±3.48^{A}	3.47±2.74^{AB}	1.39±1.76	1.62±1.05	0.70±1.16	20.13±2.74^{A}
Shoulder	M	7.87±2.12	2.31±2.89	1.85±0.80*	0.93±1.60	1.85±0.80	18.52±5.26
	F	7.87±0.80	3.24±1.60	0.00±0.0	0.46±0.80	0.93±0.80	20.83±1.39
	M+F	7.87±1.43^{AB}	2.78±2.15^{AB}	0.93±1.13	0.69±1.16	1.39±0.88	19.67±3.66^{A}
Hip	M	7.40±1.60	2.78±0.0	0.93±0.80	1.39±0.0	0.46±0.80	20.37±2.12
	F	9.72±6.36	4.17±4.81	0.00±0.0	0.93±1.60	0.93±0.80	17.59±1.60
	M+F	8.56±4.34^{AB}	3.47±3.13^{AB}	0.46±0.72	1.16±1.05	0.70±0.76	18.98±2.27^{A}

Asterisks indicate significant differences between both sexes for a given body region (P<0.05); different superscripts within a column indicate significant difference among body regions (P<0.05).

only in forearm and shoulder regions. Rams had significantly higher density of sebaceous glands than ewes (P<0.05).

The only sex-related significant difference in the density of arrector pili muscles was recorded in rump skin. This value in ewes was higher than in rams (P<0.05).

The most significant sex-based differences were observed in the density of blood vessels (neck, leg, rump and flank). All values in rams were higher than those in ewes (P<0.05).

Among body regions, the highest frequency of connective tissue was observed in leg skin (24.77±2.23). Sexual dimor-

phism was not detected in connective tissues densities (Table 1). In the present study, there were no significant regional and sex effects on quality of wool.

DISCUSSION

The highest and lowest densities of hair follicles were found respectively in rump and belly ($P<0.05$) skin samples. Carter (1943) in woolled sheep and Margolena (1954) in the Karakul found hair follicle density to be the highest on the neck, shoulder and back regions of the body and to decrease towards the belly and extremities. Fibre density is subject to large variation between animals and over the skin of the same animal. It is interesting to note that the areas with the thickest skin, such as rump, hip, neck and shoulder, had a higher density than areas with thin skin (e.g. the belly and leg). Sex-related differences were not observed for this value.

When the overall follicle density per one mm^2 of flank skin in Bakhtiari sheep (6.25±1.45) is compared to those in Lori (6.19±0.23) (Abbasi *et al.,* 2008) and other Iranian sheep breeds (16.0±0.7) (Ansari-Renani *et al.,* 2011), it could be seen that values for Bakhtiari sheep were higher than those in Lori, but the lower compared to other Iranian native breeds (Ansari-Renani *et al.,* 2011). Also, the mean follicle density of shoulder region in Bakhtiari sheep (7.87±1.43) was higher than that in the Lori breed (5.66±0.26). It can be therefore assumed that the quality of Bakhtiari sheep skin is better than that of Lori sheep.

The mean density of total follicles per mm^2 in the various regions of skin was 4.17–11.80 in Bakhtiari sheep, while in Lori (Abbasi *et al.,* 2008), Merino and their hybrids (Andrews *et al.,* 1998) and Swedish Peltsheep (Butler *et al.,* 1993) the respective values were 6.06, 21.7 and 14–19. In this study, the mean follicle density in various regions of the skin in rams and ewes was 4.63–16.66 and 2.32–9.72 respectively, while in Lori – 5.92 and 6.2 respectively (Abbasi *et al.,* 2008).

Sex-related differences in total follicle densities were not observed in Lori sheep (Abbasi *et al.,* 2008), however, Ansari-Renani *et al*. (2011) reported higher total follicle densities of flank skin in males of some Iranian sheep breeds than in females. In the present study, no significant effects of sex on total follicle density could be demonstrated.

In Bakhtiari sheep, there was evidence for sex-related differences in the density of sweat glands in leg and forearm regions, which were more numerous in ewes than in rams ($P<0.05$). Comparing the maximum and minimum densities of sweat glands and hair follicles in the belly region with those of the rump, it was determined that the hair follicles in belly region were replaced with sweat glands.

Warren *et al.* (2008) reported that the sebaceous gland area per unit length of flank skin in Merino ewes was 24.27± 1.54. This value in Bakhtiari sheep was substantially lower (1.39±1.39).

In conclusion, although the quality of Bakhtiari sheep skin could be assessed as better than that in Lori sheep, it was similar to other common Iranian carpet wool sheep breeds and may be recommended for carpet wool production.

ACKNOWLEDGEMENTS

The author is grateful to the School of Veterinary Medicine of Islamic Azad University, Shahrekord Branch, for providing financial assistance.

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Paper received 14.06.2012; accepted for publication 27.09.2012

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