



Effect of age and sex on fiber and follicle characteristics of an Iranian native sheep

B Mobini

Department of Anatomical Sciences,
School of Veterinary Medicine, Islamic Azad University, Shahrekord branch,
P.O.Box:166. Shahrekord, Iran.

*Correspondence: Tel.: +989139168248, E-mail: dr.mobini@iaushk.ac.ir

Abstract

The mammalian hair fibers represent an interesting biological material which also is used in the textile industry. Histological structures of the fibers and follicles differ not only among different species but also among different areas and ages in an animal species. Skin samples were collected from neonatal (1-2 months), young (3-9 months), young adult (1-2 years) and old adult age groups (3 years and more). In each age group, six animals (3 each sex) were utilized. Immediately after slaughtering the animals, tissues were collected from eight regions namely belly, neck, leg, rump, flank, forearm, shoulder and hip and were fixed in 10 percent neutral buffered formalin. Histologic sections were stained with hematoxylin-eosin and special stains. It was found that the general histological features of all Bakhtiari sheep fibers used in this study were similar to many other breeds sited in literature, however there were also some differences. All hairs of the various skin regions had a medulla. All the hair follicles were surrounded by associated structures such as the sweat and sebaceous glands and arrector pili muscles and located only in papillary layer of the dermis. The most common number of the secondary hair follicles in compound hair follicles was 4. The histology of all fibers and follicles in various skin regions showed no significant differences by sex in all the age groups studied. By age increase, all the fibers and their follicles were larger and well organized in all different skin regions.

Keywords: Bakhtiari, breed, fiber, follicle, sheep, skin

Introduction

In general, there are two categories of skin appendages, characterized by either protrusion out of or invagination into the body surface. The skin appendages that protrude out of the body surface include hairs, feather, nails and scale. They provide a variety of functions to individuals, ranging from environmental protection to ritual mating displays (Widelitz *et al.*, 1997). The skin appendages that invaginate are the sebaceous gland, sweat gland and mammary gland. They provide specialized physiological functions to individuals, ranging from environmental adaptation to lamb rearing (Widelitz *et al.*, 1997).

Sheep are important animals worldwide for the provision of animal protein and wool. Their other products such as fiber, milk, skins or dung are also important as a source of income for small holders in the less developed parts of the world (Mahgoub *et al.*, 2010). There are several native breeds of sheep in Iran. The breeds are named in relation to their place of origin or the tribe of the owner (Kiyanzad *et al.*, 2003). One of the main breeds is Bakhtiari found

in West and Southwest of the country especially in Charmahal va Bakhtiari province. The aim of this study was to investigate the histological characteristics of fibers and follicles in various skin regions of Bakhtiari sheep and effects of age on these structures.

Materials and methods

Twenty-four Bakhtiari sheep were selected according to their phenotypic features. The animals were allocated to one of four groups. Neonatal (1-10 days; $n=6$), Young (5-8 months; $n=6$), Young adult (1-2 years; $n=6$), Old adult (3 years and more; $n=6$). In each age group, three males and three females were used. Skin samples 3 cm² were taken 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 fixed in 10 percent neutral buffered formalin solution. The specimens were then processed through a serial steps for histological examinations. Tissue samples were stained by a variety of techniques for general

observations and types of connective tissue fibers; (1) hematoxylin eosin, (2) Masson's trichrome, (3) Van gieson's, (4) Foot's method for reticulum, (5) Ayoub-Shklar (Luna, 1968) and (6) Verhoeff's (Mallory, 2010). Histologic studies of fibers and follicles among different skin regions of an animal, between different sexes and also among different groups on these sections were carried out using light microscope. Photographs were taken using a Canon digital camera (Ixus 990, IS).

Results

In this research, no significant difference in various structures of skin between male and female was observed. In all hairs (primary, secondary) of the various regions of skin of all Bakhtiari sheep, the medulla was present and the sweat glands, sebaceous glands and arrector pili muscles existed around all the hair follicles (Plate I).

Each primary hair follicle in all the regions of skin and in all the four age groups of Bakhtiari sheep possessed the two layers of collagen (Plate II), reticular (Plate III) and elastic layer in both sexes (Plate I).

Elastic fibers were arranged in the following two regions of hair follicle: 1) around the external root sheath just beneath the collagen fibers of dermal sheet and 2) between the external and internal root sheaths (Plate I). Immediately below the entrance of the sebaceous glands, the inner root sheath of the hair follicles became corrugated and formed several circular folds (Plate I). The sheath then become thinner and the cells merged, disintegrated and form

part of the oil produced by sebaceous glands (sebum).

The amount of collagen fibers in dermal sheet of hair follicle were very high, but elastic fibers were less (Plate I & IV).

The compound hair follicles which were observed only in some areas composed of one primary follicles and different numbers of secondary follicles (Plate III & IV). The maximum number of secondary hair follicles was 6, but in most compound hair follicles, cluster of 4 were most common (Plate III).

In this study, the following significant histological differences among the regions and different age groups were found:

- 1- The hair follicles of hip and flank skin of young sheep presented only in the upper part of papillary layer of dermis, but in other regions and age groups they were observed in the whole papillary layer of dermis.
- 2- All the hairs and hair follicles were larger and well organized in young adult sheep and more.
- 3- All hairs of the various skin regions had a medulla, sweat glands, sebaceous glands and arrector pili muscles in all the age groups studied.
- 4- The numbers of compound hair follicles of skin in all the age groups were found to be maximum on the shoulder, rump, flank and neck, respectively.
- 5- The most common numbers of secondary hair follicles within different compound hair follicles were four.

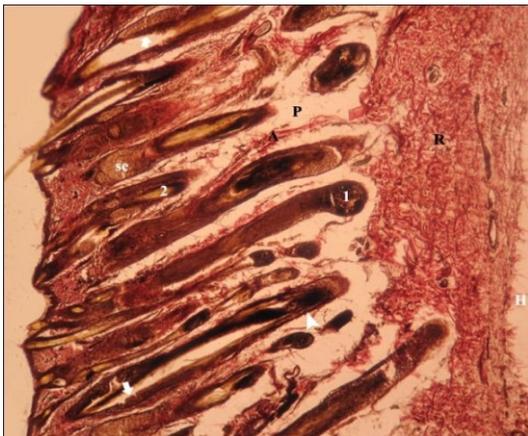


Plate I: The rump skin of Bakhtiari sheep aged 1-10 days. Papillary layer (P) and reticular layer (R) of the dermis, hypodermis (H), sebaceous glands (se), primary (1) and secondary hair follicle (2), arrector pili muscle (A) and elastic fibers (arrowheads). The arrows indicate follicular circular folds. Verhoeff's $\times 100$

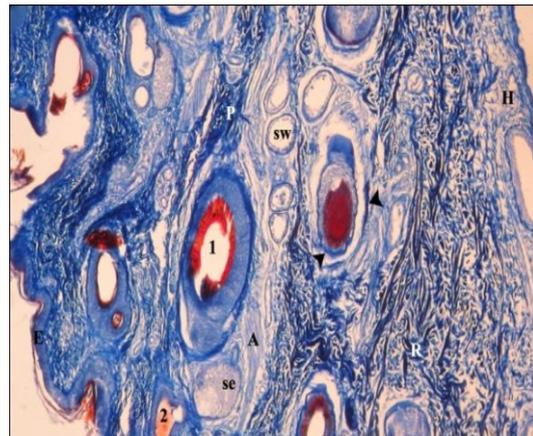


Plate II: The forearm skin of Bakhtiari sheep aged 5-8 months. Papillary (P) and reticular layer (R) of the dermis, hypodermis (H), sebaceous glands (se), sweat glands (sw), primary (1) and secondary hair follicle (2), arrector pili muscle (A). The arrowheads indicate two layers of collagen fibers around each follicle. Ayoub-Shklar $\times 100$

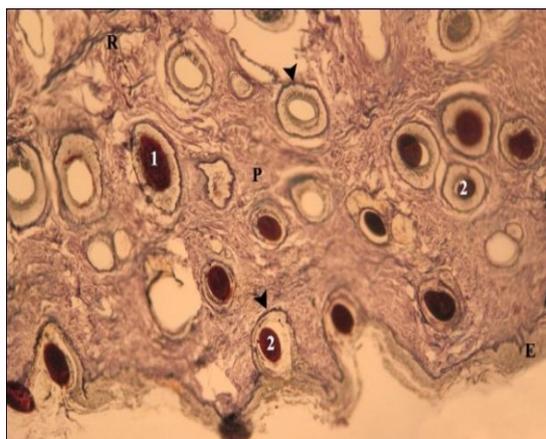


Plate III: Epidermis (E), Papillary (P) and reticular layer (R) of the dermis, primary (1) and secondary hair follicle (2) in the skin of Bakhtiari sheep aged 3 years. All the hair follicles surrounded by reticular fibers (arrowheads). Foot's method for reticulum $\times 100$

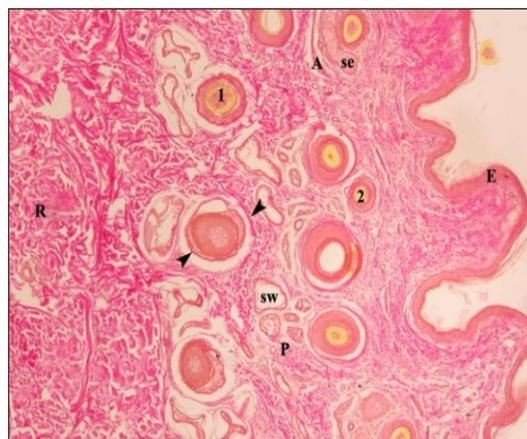


Plate IV: Epidermis (E), Papillary (P) and reticular layer (R) of the dermis, primary (1) and secondary hair follicle (2), arrector pili muscle (A), sebaceous (se) and sweat glands (sw) in the hip skin of Bakhtiari sheep aged 5-8 months. All the hair follicles surrounded by two layers of collagen fibers (arrowheads). Van gieson's $\times 100$

Discussion

In this research, no significant sex-related difference in various structures of skin was observed. Similar results were also reported by Yeruham *et al.*, (1997) in Assaf, Merino and Awassi breeds.

The sweat glands, sebaceous glands and arrector pili muscles were found around all the hair follicles, while Dellmann (1993) has stated that the secondary hair follicles may have the sebaceous glands but lack the arrector pili muscles.

Unlike *Capra prisca* goats which in many of the guard hairs no medulla was observed (Pourlis & Christoulopoulos, 2008), all hairs of the various skin regions of all Bakhtiari sheep had medulla.

Each primary hair follicle in all the regions of skin and in all the four age groups of Bakhtiari sheep possessed the two layers of collagen, reticular and elastic layer in both sexes, while Dellmann (1993) reported only presence of the collagen and elastic layer without explanation of the number of each layer.

In this study, inner root sheath of the hair follicles had several circular folds and the compound hair follicles were composed of one primary follicles and different numbers of secondary follicles. These results in Bakhtiari sheep agree with the results obtained by Dellmann (1993).

In Bakhtiari sheep, the number of secondary follicles in most compound hair follicles was 4. These

findings varied significantly with the previous reported arrangements of the compound hair follicles in sheep that each follicle cluster contained 3 primary follicles and several secondary follicles (Dellmann, 1993).

In this study, elastic fibers were arranged in the two regions of hair follicle, whereas Dellmann (1993) reported only presence of the collagen and elastic around each hair follicle, and did not mention the number of each layer.

Amount of collagen fibers in dermal sheet of hair follicle in Bakhtiari sheep were very high, but elastic fibers were less. In mammalian skin, collagen is the most abundant structural constituent of the dermis, comprising about three quarters of the dry weight of this part of the integument. The collagen reacts with tanning agents to form the leather substances. The number of elastic fibres present in papillary layer is also important for leather production (Mir Shabir *et al.*, 2011).

It is concluded that the fiber and follicle characteristics of Iranian Bakhtiari sheep had similarities with those of other breeds and some distinct differences.

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