Original Research

Histomorphogenesis of Arrector Pili Muscle in Prenatal Goat (*Capra hircus*)

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Abstract

Study on the histogenesis of goat skin was conducted on the 36 goat embryo/foetuses of local non-descript breed. The material was divided into three group's viz. Group I (below 50 days of gestation), Group II (51-100 days of gestation) and Group III (101 days – 150 days of gestation) containing 12 foetuses each group. The skin samples were collected from eight different regions of body except in group I. The tissue samples were processed as per routine paraffin embedding technique. 5-6 µ thick sections were stained with hematoxylin and eosin method. The arrector pili muscle was observed first time in face region at 87 days gestation in the form of differentiating myocytes in dermis. At 94 days gestation the myocytes appeared in the dermis of neck, shoulder, back, abdomen, flank and thigh regions of goat foetus. From 99 days gestation the myocytes showed fiber like profile to form oblique rows of myocytes in the vicinity of hair follicles and in face regions these appeared as thin bundles of smooth muscles which were attached by their one end to the hair follicles and extended obliquely to the dermo-epidermal junction. From 118 days of gestation fully developed arrector pili muscles were observed on the obtuse angle side of hair follicles in all body regions except in chin region which were attached by their one end at hair follicle bulb and by the other end at dermo-epidermal junction.

Key words: Arrector Pili Muscle, Goat, Histomorphogenesis, Prenatal, Skin

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Introduction

Goats (*Capra hircus*) are reared throughout the world for providing the animal protein in the form of meat and milk to the human beings. Their slaughter by-products, the skin and fibers are utilized as raw material by the leather and textile industries. Skin is the outermost covering of all vertebrates and holds their all

internal organs together. It is the largest and heaviest organ of the body and makes about 16% of its weight (Hejazi *et al.*, 2013). In the year 2014, India produced 90.5 thousand tons of goat skin from 90492 thousand pieces of goat skin (FAO, 2016). The appendages of skin include hair follicle, sebaceous gland, sweat gland, and arrector pili muscle. The arrector pili muscle mediates thermoregulation by contracting to increase air-trapping and connects hair follicles to dermo-epidermal junction (Torkamani *et al.*, 2014). Although, the arrector pili muscle play important role in maintaining health of animals, very little attention has been put towards the prenatal development of this muscle in goat. Looking into above facts the present study was planned reveal the sequential histological features of arrector pili muscle at different stages of gestation in goat.

Materials and Methods

The study was conducted on the skin of thirty six apparently healthy goat embryo/ foetuses of none descript breed. Immediately after collection, the weight of the embryo/ foetus was recorded. Approximate age of the embryos (upto 30 days of gestation) was estimated on the basis of foetal measures and phenotypic characteristics given by Njaa (2012) and Anonymous (2008) in goat. The age of the remaining embryos/ foetuses was estimated by using the formula derived by Singh *et al.* (1979) in goat after interpolation of formula of Hugget and Widdas (1951). The embryos/ foetuses were divided into three age groups each with twelve embryos/ foetuses *viz.* group-I (0-50 days), group-II (51-100 days) and group-III (101-150 days). In group I upto 44 days gestation whole embryos/ foetuses were processed and in others, one longitudinal half of the foetuses was processed. In group II and group III skin samples from eight different body regions viz., face, neck, shoulder, back, abdomen, flank and thigh regions were processed for paraffin sectioning technique. The sections of 5-6 µm thickness were cut and stained with hematoxylin and eosin (Luna, 1968) for histological study.

Result and Discussion

The arrector pili muscle was absent in the skin of chin region in goat foetuses and were observed first time only in face region at 87 days gestation in the form of myocytes scattered in the deeper part of dermis. At this stage the myocytes were in varying stages of differentiation. Several of these had cylindrical cone like filamentous eosinophilic extensions either at their one end or at both ends; many of these extensions had rounded ends where as many other had tapering ends (Fig. 1). Several other myocytes in this foetus were elongated in appearance and had fiber like profile; these had darkly stained either flattened or oval centrally placed nuclei or eosinophilic cytoplasm. Hejazi *et al. (*2013) in sheep foetus observed smooth muscle cells in the dermal tissue between 11th and 12th week of gestation. Purushotham (2007) in New Zealand white rabbit foetus observed these muscles at 25 days of gestation. According to Arey (1974) in human foetus

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and Hyttel *et al. (*2010) in foetal domestic animals the lower swelling of outer epithelial wall of hair follicle, the epithelial bud which served as the site for attachment of arrector pili muscle, induced the mesenchymal cells to differentiate into smooth muscle cells. Singh (2006) reported the presence of arrector pili muscle in the dermis of 151 days old buffalo foetus, however, according to Chaurasia *et al. (*2009) the arrector pili muscle first appeared in the mammary gland skin of goat foetus at 93 days gestation.

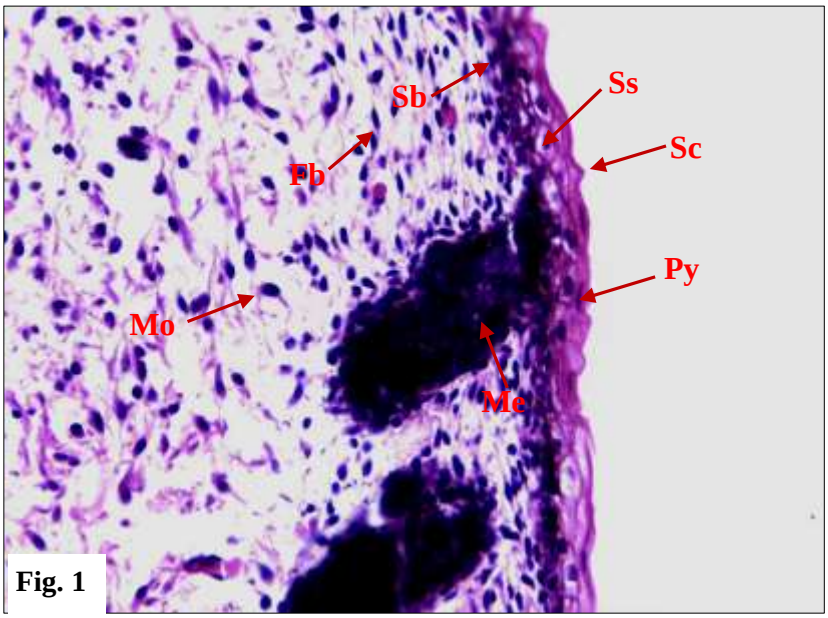

Fig. 1

Fig. 1: Photomicrograph of skin of face region of 87 day old goat foetus showing stratum basale (Sb), stratum spinosum (Ss), pyknotic nuclei (Py) in stratum granulosum and stratum corneum (Sc) in epidermis, melanocyte (Me) in hair follicle and myocyte (Mo) in dermis. (H & E, X 400)

At 94 days gestation the myocytes were observed in the dermis of neck, shoulder, back, abdomen, flank and thigh regions of goat foetus in addition to its face region. Other than face region the structure of myocytes was almost similar as it was observed in the face region of 87 days old foetus. In face region most of the myocytes were in the form of muscle fibers which had centrally placed dark staining either oval or spindle shaped nuclei; these showed the characteristics of smooth muscles. The muscle fibers were obliquely oriented thin eosinophilic cord like structures which were present in the middle part of dermis in the vicinity of developing hair follicles towards their obtuse angle side. At few places one end of these developing arrector pili muscles were attached to a swelling on the terminal part of hair follicles where as their other end was attached to the dermo-epidermal junction. In Angora goat foetuses the arrector pili muscle extended upward close to the epidermis above the sudoriferous gland duct (Margolena, 1974). In 99 and 100 days old foetuses of present study the myocytes were observed in deeper two third part of dermis in all the above mentioned regions and several of these places had elongated fiber like profile (Fig. 2). At some places, particularly in neck, shoulder, abdomen and flank regions the myocytes having fiber like

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profile were arranged one after other to form oblique rows of myocytes in the vicinity of hair follicles. This might be a process in the formation of arrector pili muscles. In face region of these stages the arrector pili muscles were relatively more differentiated and were in the form of thin bundles of smooth muscles which at all places were attached by their one end to the hair follicles and extended obliquely to the dermo-epidermal junction where these were attached. Akiyama *et al. (*2002) in human foetus observed that the smooth muscle cells of arrector pili grew towards the hair follicles and attached to the follicles in the region of bulge around 15 week of gestation. Singh (2006) in buffalo foetus reported the presence of arrector pili muscle in the dermis of 151 days old foetus which were properly differentiated in the form of starnd like structure at 174 days gestation, however, according to Chaurasia *et al. (*2009) the arrector pili muscle first appeared in the mammary gland skin of goat foetus at 93 days gestation. Hejazi *et al. (*2013) in sheep foetus reported the presence of arrector pili muscles between 16th – 18th week of gestation.

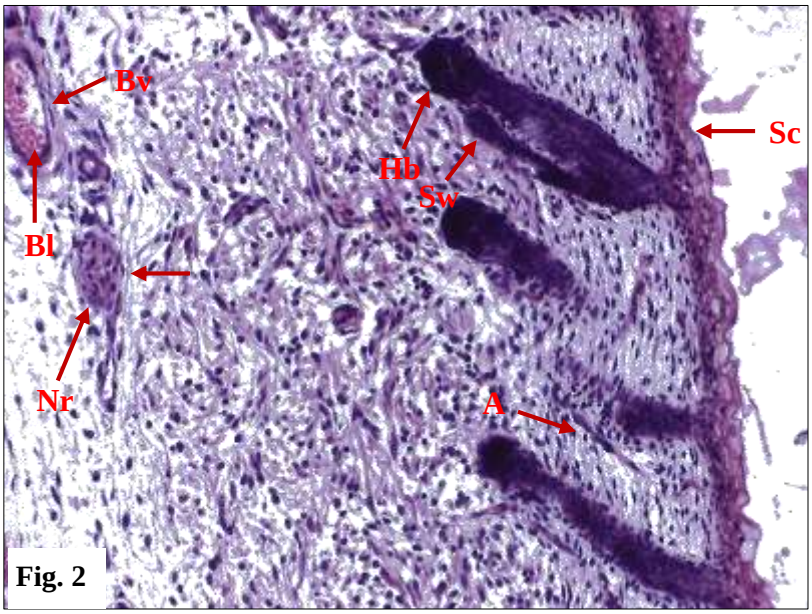

Fig. 2: Photomicrograph of skin of face region of 100 day old goat foetus showing stratum corneum (Sc) in epidermis, arrector pili muscle (A), blood vessel (Bv), blood cells (Bl) and nerve (Nr) in dermis, hair bulb (Hb) in hair follicle and sweat gland (Sw). (H & E, X 200)

In 102 days gestation the arrector pili muscle was in the form of delineated cords of obliquely oriented smooth muscle found close to the obtuse angle side of some hair follicles but these were neither attached to the hair follicle nor to dermo-epidermal junction except in face region (Fig. 3). These findings are in agreement with the results of Margolena (1974) stated that the hair muscle fibers in angora goat at 90 days gestation were delineated cord of mesodermal cells found on the obtuse side of slanting primary follicles.

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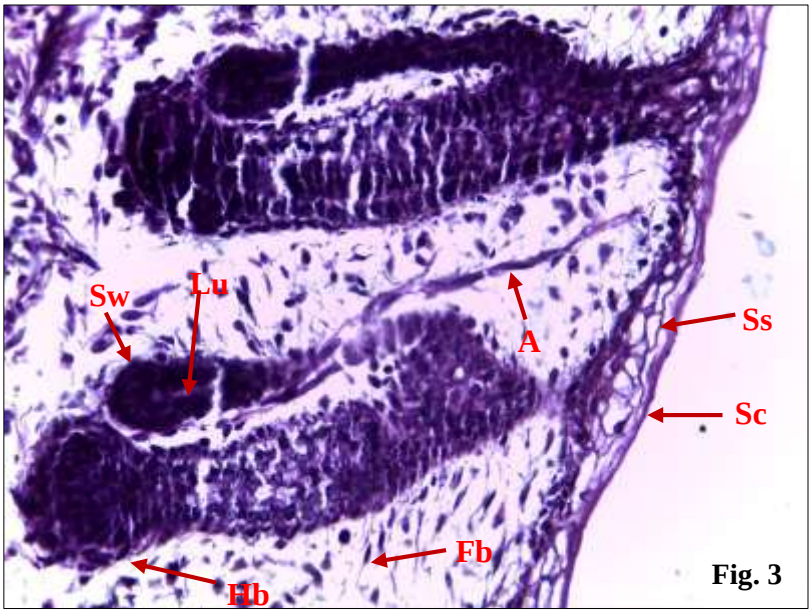

Fig. 3: Photomicrograph of skin of face region of 102 day old goat foetus showing stratum spinosum (Ss) and stratum corneum (Sc) in epidermis, arrector pili muscle (A) and fibroblast (Fb) in dermis, lumen (Lu) in sweat gland (Sw), and hair follicle bulb (Hb). (H & E, X 400)

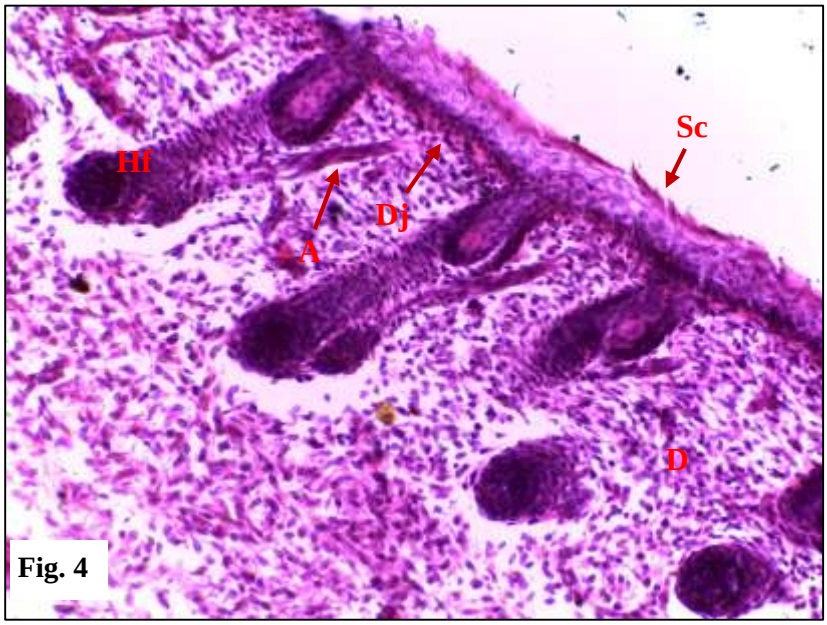

Fig. 4: Photomicrograph of skin of abdomen region of 114 day old goat foetus showing stratum corneum (Sc) in epidermis, arrector pili muscle (A) associated with dermo-epidermal junction (Dj) and hair follicle (Hf), in dermis, melanin (Ml), hair cone (Hc), hair bulb (Hb) and dermal papilla (Dp) in hair follicle, and dermis (D). (H & E, X 200)

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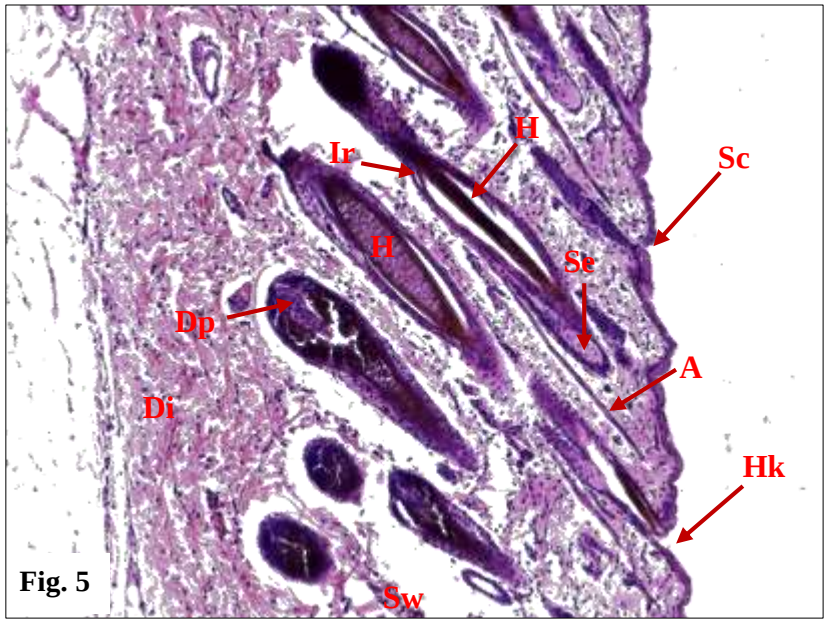

Fig. 5: Photomicrograph of skin of flank region of 134 day old goat foetus showing stratum corneum (Sc) and hair canal (Hk) in epidermis, inner root sheath (Ir), hair (H), dermal papilla (Dp) in hair follicle, arrector pili muscle (A) and dense irregular connective tissue (Di) in dermis, and sebaceous gland (Se). (H & E, X 100)

In 106 and 108 days gestation the arrector pili muscles of shoulder, back, flank and thigh regions in goat foetus were usually attached with hair follicles and extended obliquely upward towards the epidermis but does not reached upto the dermo-epidermal junctions. In face and abdominal regions these extended obliquely from hair follicles to the dermo-epidermal junctions. At 114 days the muscles were attached to hair follicles by their one end and to dermo-epidermal junction by their other end were found in face, abdomen and flank regions (Fig. 4) and from 118 days gestation these were fully developed as obliquely oriented slender cord like arrector pili muscles were observed on the obtuse angle side of hair follicles in all body regions except in chin region which were attached by their one end at hair follicle bulb and by the other end at dermo-epidermal junction. In 121, 134, 145 and 150 days old goat foetuses foetuses the structure of arrector pilli muscles remained almost unchanged and was found as it was observed in 118 day old foetus (Fig. 5). Torkamani *et al.* (2014) stated that the arrector pili muscle consists of a small band of smooth muscle that connects the hair follicle to the connective tissue of the basement membrane which mediates thermoregulation by contracting to increase air-trapping, but was thought to be vestigial in humans.

Conclusion

The arrector pili muscles were observed as myocytes in face region at 87 days gestation. In 94 days old foetus the arrector pili muscles were cord like in face region where some of these extended between the

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hair follicles and dermo-epidermal junction. Beyond 102 days gestation these were in the form of obliquely directed delineated cords located towards the obtuse angle side of hair follicles. Beyond 118 days gestation arrector pili muscles were fully developed and were attached by their one end to the hair follicles and by the other end to the dermo-epidermal junction in all body regions.

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