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HISTOARCHITECTURE OF THE STROMAL ELEMENTS OF THE TESTES OF ADULT CROSSBRED SHEEP AND NON-DESCRIPT GOAT OF JAMMU REGION- A COMPARATIVE STUDY

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ABSTRACT

The present study investigated the histological architecture of the testicular capsule, trabeculae, mediastinum testis, tubuli recti and rete testis in crossbred sheep and non-descript goats. The testes of both species were enclosed by a thick capsule composed of dense irregular connective tissue forming the tunica albuginea, externally covered by the visceral layer of the tunica vaginalis. The capsule consisted of an outer tunica fibrosa and inner tunica vasculosa, with the former being thicker and predominantly composed of collagen fibres along with elastic and reticular fibres. The tunica vasculosa contained large blood vessels contributing to rich vascularization of the testis. Smooth muscle cells were observed within the fibrous capsule, mainly associated with blood and lymphatic vessels. Septa arising from the capsule extended into the parenchyma, dividing it into indistinct lobules and providing pathways for vessels and nerves. The mediastinum testis was centrally located and extended along most of the longitudinal axis. It contained connective tissue, blood and lymph vessels, and various cell types including fibroblasts, macrophages and mesenchymal cells. The rete testis and tubuli recti were lined by simple cuboidal epithelium with a distinct basal lamina, supported by collagen and reticular fibres. The epithelial cells resembled Sertoli cells. Overall, the histological features observed in both species were comparable and consistent with earlier reports in domestic animals.

Key words: Capsule, Goat, Histology, Sheep, Testis

Introduction

Goat husbandry is a traditional practice in the Union Territory of J&K. The tribals, *viz*. Bakerwals, Gaddies, and Changpas are highly skilled in sheep and goat rearing. Goat is principally reared for milk, meat, fiber (Pashmina and Mohair), hide, and skin. The skin is primarily utilized in the leather industry. This helps the locals earn considerable export earnings (Hamadani *et al.*, 2022). Also, within the national framework, the regions of Jammu & Kashmir (J&K) and Ladakh hold a significant position, collectively ranking 6th in the country for sheep population, as noted by Hamadani *et al*., (2022). Sheep and goat, being well conformed and stress resilient animals, thrive better in the hilly and other inaccessible areas where it is difficult for other livestock to cope with the adversities of terrain and harsh environment, warrants food and economic security for the poor communities (Khan *et al.*, 2013).

The testis is a primary organ that produces testosterone and spermatozoa and so provides both endocrine and exocrine roles. The parenchyma of the testicle consists of seminiferous tubules, responsible for spermatozoa production and ongoing spermatogenesis, and Leydig cells, which produce testosterone to support male sexual traits. (Hafez, 2000). The testicles of most mammals, including stallions, rams, bulls, llamas, deer, and boars, are complicated tubular organs that are supported by the tunica albuginea, a dense, irregular connective tissue capsule. White, reticular, and elastic fibers, as well as fibroblasts and a few vessels, are found in this capsule (Mahmud *et al*., 2015).

A thorough review of the existing scientific literature reveals a notable scarcity of comprehensive, comparative anatomical data pertaining to the testis and epididymis of adult crossbred sheep and the local, non-descript goat populations. This significant gap in knowledge provided the primary impetus for the current investigation. Consequently, the present study was undertaken to conduct a detailed comparative anatomical analysis of this critical reproductive organ in crossbred sheep and non-descript goats indigenous to the Jammu region of the Union Territory of Jammu and Kashmir.

Material and Methods

A total of 20 samples of (10 from each species of animal) testis from freshly slaughtered apparently healthy adult non-descript sheep & goats varying in age from 1.5 to 3 years were collected during the month from May to August from the slaughter houses located in and around Jammu city and were immediately brought to the laboratory of the Division of Veterinary Anatomy, F.V.Sc. & A.H., SKUAST-J, R.S. Pura. The age of the goats was estimated by examining the dentition. Immediately after reaching the laboratory, the gross anatomical features of the testis and epididymis were studied. The samples from non-descript goat were collected between December 2023 and April 2024, and the same from crossbred sheep were collected between May and August 2024.

For the microscopic analyses, tissue samples were systematically collected and prepared. From the testis, tissue pieces were excised from three distinct regions: the upper, middle, and lower poles. These testicular samples were subsequently fixed in Bouin's solution as per Luna (1968).

Following fixation, all tissue samples were processed for paraffin embedding using the standard alcohol-xylene dehydration and clearing method, as described by Luna (1968). The embedded tissues were then sectioned at a thickness of 5 µm using a Rotary Microtome. These sections were subsequently mounted and subjected to a battery of staining procedures for various histomorphological and histochemical techniques as detailed below.

Table 1: Showing different stains used for histomorphological studies.

1	Haematoxylin and Eosin	(Luna, 1968)
2	Mallory's method for collagen	(Luna, 1968)
3	Weigert's method for elastic fibres	(Luna, 1968)
4	Gomori's method for reticular fibres	(Luna, 1968)
5	Bielschowsky's method for nerve fibres	(Humason, 1967)

Results and Discussion

Capsule and trabeculae

In the present study, the testes of both crossbred sheep and non-descript goat were enclosed by a thick capsule (Fig. 1) that was composed of dense irregular connective tissue, the tunica albuginea. The tunica albuginea was of the testis was externally covered by a mesothelial cell layer, the visceral layer of the tunica vaginalis. The capsule of the testis was composed of two layers *viz*. outer tunica fibrosa and inner tunica vasculosa, the former being thicker (Fig. 2). The outer tunica fibrosa consisted predominantly of collagen fibres

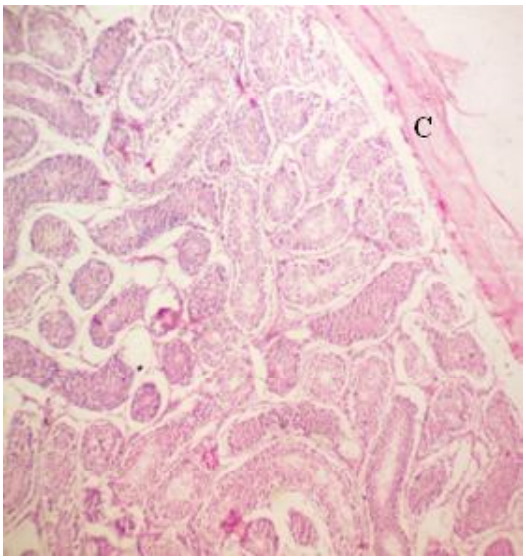

Fig 1: Photomicrograph of the testis of adult non-descript goat showing thick capsule (C). x40, H&E stain.

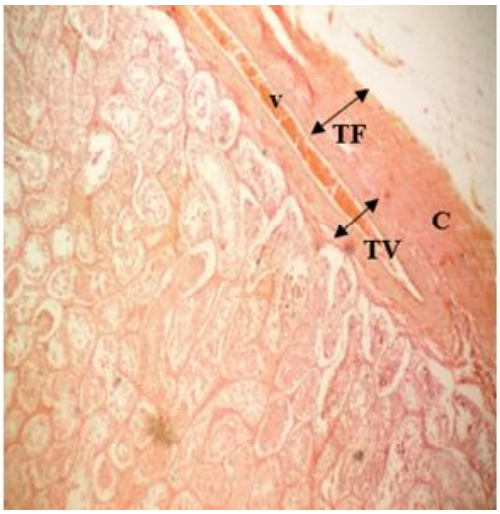

Fig 2: Photomicrograph of the testis of adult cross-bred sheep showing capsule (C) having tunica fibrosa (TF) and tunica vasculosa (TV) and a large blood vessel (v), x40, H&E.

(Fig. 3). Elastic fibers were also found and they were mainly located in the tunica intima of blood vessels of tunica vasculosa (Fig. 4). Fine reticular fibres were also observed in the tunica fibrosa layer. The tunica vasculosa layer contained large blood vessels (Fig. 5) in both the species of animals. These observations were corroborated with the previous reports in Hassan rams (Naik *et al.*, 2023), in domestic animals (Eurell and Frappier, 2006), in horse (Shukla *et al.*, 2013), domestic pig (Reddy *et al.*, 2016), in deer (Moonjit and Adchratt, 2017), Black Bengal goats (Islam *et al.*, 2002), local goats of Nagpur (Karmore *et al.*, 2003) and in buffalo calves (Ramaya *et al.*, 2007). In both crossbred sheep and non-descript goat, the tunica albuginea was consisted of large blood vessels which contributed to a rich blood supply to the testis as also reported in rat (Khattab, 2007) and in domestic animals (Eurell and Frappier, 2006).

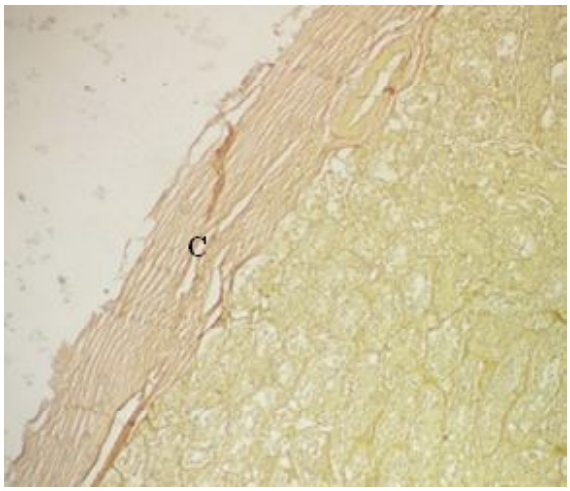

Fig 3: Photomicrograph of the testis of adult non-descript goat showing collagen fibres in the capsule (C). x40, Von Gieson method.

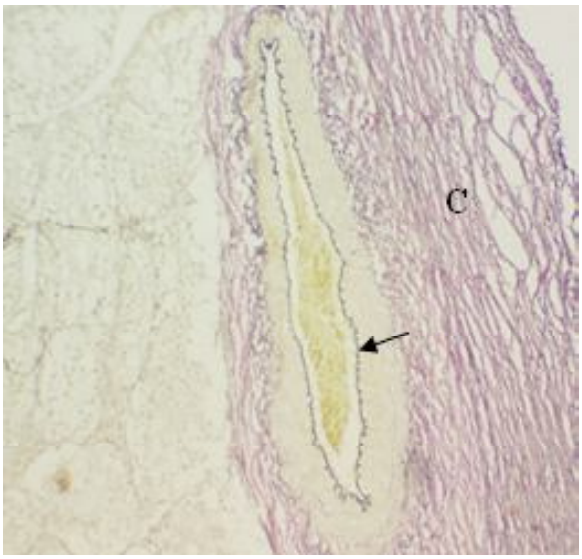

Fig 4: Photomicrograph of the testis of adult crossbred sheep showing collagen fibres in the capsule (C) and elastic fibres in the tunica intima of blood vessel (arrow). x100, Weigert's method.

Smooth muscle cells were also seen in the fibrous layer of the capsule. Arellano and Woolley (1980) reported that small bundles of smooth muscle cells could be observed in the deeper layers of the capsule, most often accompanying blood vessels or lymphatic vessels in sheep. They also opined that, smooth muscles cells in the tunica albuginea of the testis in pig was relatively less in pig, while in horse there was an abundance of smooth muscle cells in the tunica albuginea that constituted a layer about 0.3 µ thick just beneath the tunica albuginea.

The capsule of the testis extended deep into the parenchyma of the organ in the form of septae proceeding towards the mediastinum testis and divided the testicular parenchyma into varying amount of indistinct testicular lobules and formed the passage for blood vessels and nerves. These findings were in similar with the description in Hassan ram (Naik *et al.*, 2023), in domestic animals (Eurell and Frappier, 2006) and in domestic pig (Reddy *et al.*, 2016).

Tubuli Recti, Mediastinum Testis and Reti Testis

In all the animals of both the species under study, the septula testis converged to the central axis of the testicular parenchyma to form mediastinum testis (Fig.6). The mediastinum testis was nearly centrally placed in the testis and extended from the head to over two- thirds of the longitudinal axis towards caudal extremity. However, the position of the mediastinum testis in the

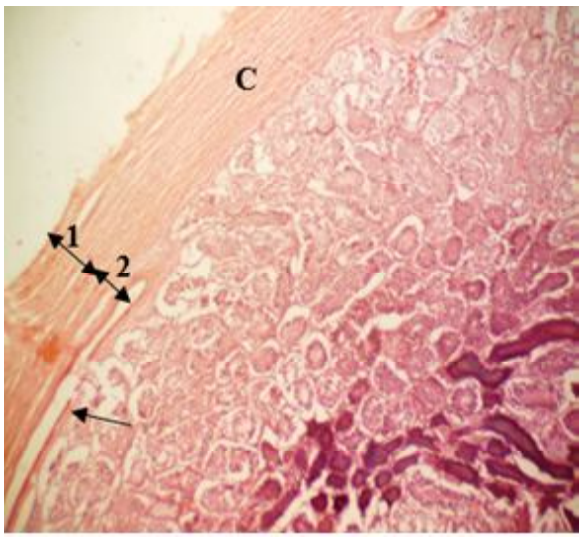

Fig 5: Photomicrograph of the testis of adult non-descript goat showing capsule (C) having tunica fibrosa (1) and tunica vasculosa (2) and a large blood vessel (arrow), x40, H&E.

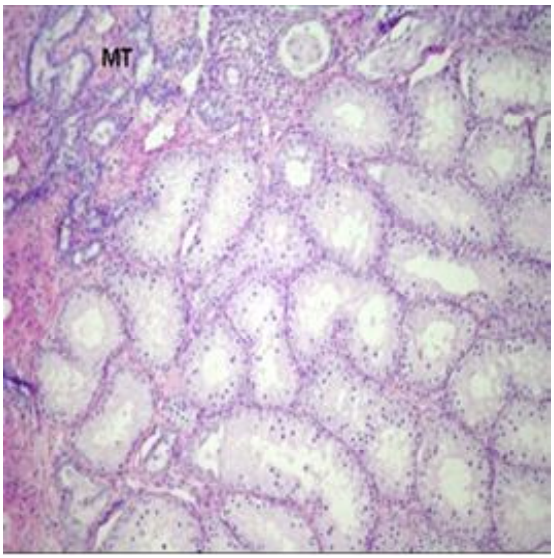

Fig 6: Photomicrograph of the testis of adult non-descript goat showing mediastinum testis (MT). x100 H&E.

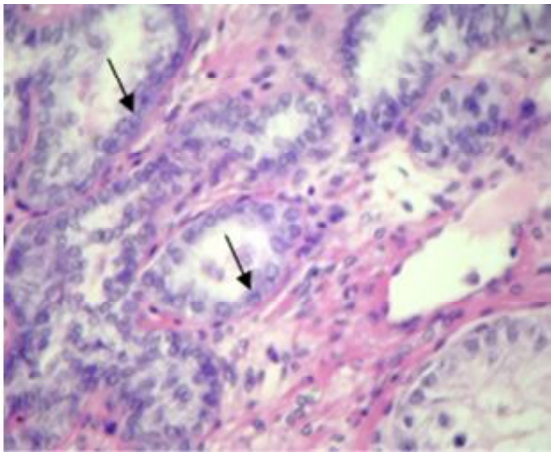

Fig 7: Photomicrograph of the testis of adult non-descript goat showing lining epithelium of rete testis (arrows). x400 H&E.

testis varied widely in different species of vertebrates being axial in domestic animals except in horses (Shukla *et al.*, 2013). As observed in our study, Goyal and Dhingra (1973) observed that the mediastinum testis in buffalo was centrally located and extended as a straight cord from the proximal extremity of the testis up to two- thirds or three- fourths of the distance to the distal extremity. Central position of the mediastinum testis also reported in rams (Schahidi and Smidt, 1980). In this study, blood vessels were also seen in the mediastinum testis. Numerous lymph vessels were located within the mediastinum, mostly in close contact to the rete channels. The different cell population of the mediastinum testis were the fibroblasts, macrophages and undifferentiated mesenchymal cells. Confirming our present study, Naik *et al.*, (2023) also opined that the mediastinum testis in sheep consisted of connective tissue, composed mainly of collagen fibres with elastic fibres and it contained labyrinthine that communicated with the rete testis. Similar observations were also reported in domestic goat (Kakade and Singh, 1990) and in domestic animals (Eurell and Frappier, 2006).

In both the species, the rete testis and the tubuli recti were lined by simple cuboidal epithelium with distinct basal lamina surrounded by blood vessels. The reticular fibres formed a network in the mediastinum testis and the rete testis. The basement membrane of the rete testis was composed of collagen and reticular fibres. Naik *et al.*, (2023) also reported that the rete testis was lined by simple cuboidal cells (Fig. 7) surrounded by loose connective tissue of mediastinum testis in Hassan ram. Similar histological features of rete testis and mediastinum testis were also reported by Orsi *et al.*, (1984) in goats. Again, the simple cuboidal cells that lined the tubuli recti and the rete testis resembled Sertoli cells as reported in buffalo (Pal and Bharadwaj, 1984 and Singh, 1996) and in goat (Sarma *et al.*, 2014).

Conclusion

The present study concluded that the testes of crossbred sheep and non-descript goats exhibit a well-developed capsule with distinct tunica fibrosa and tunica vasculosa layers, ensuring structural support and rich vascular supply. The septa and centrally located mediastinum testis effectively organize the testicular parenchyma. The histological features of the rete testis and tubuli recti, lined by simple cuboidal epithelium, indicate functional specialization in sperm transport. Overall, both species share similar microscopic architecture, consistent with descriptions in other domestic animals.

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