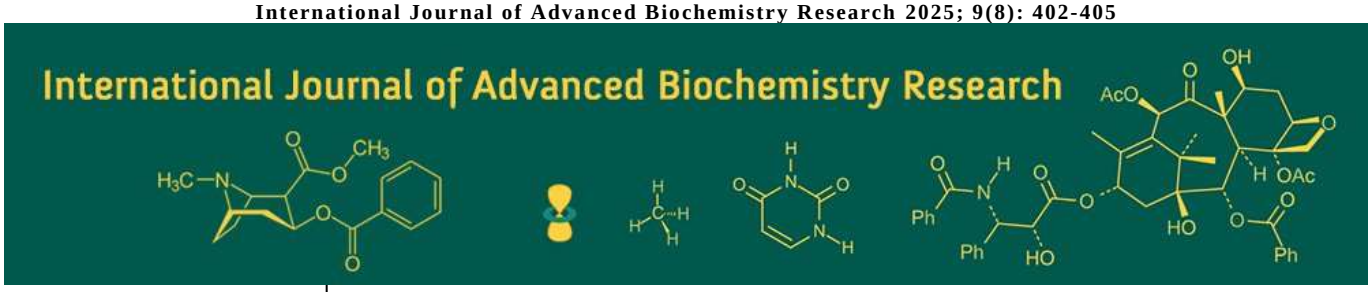

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Morphometry and gross anatomy of testis and epididymis of Mandya ram (*Ovis aries*)

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Abstract
The present study examined the six pair of testes of Mandya breed ram for the morphometric and gross characteristics and the samples were collected from six animals at local slaughterhouses in and around Bandur village, Malavalli Taluk, Mandya District, Karnataka. The paired testicles were found to be large and vertically situated cranial to the inguinal region and were suspended within the scrotum by spermatic cords. Morphologically, the testes were irregularly elliptical to oval in shape, with a convex and smooth lateral surface was enveloped by the tunica vaginalis. The medial surface was slightly flattened due to contact with the scrotal septum. The cranial border was convex and free, while the caudal border attached to the epididymis. The epididymis was elongated, curved, and closely adhered to the posterior border of the testis. Epididymis is divided into three parts: the head, body, and tail. The head was located dorsally and is irregular and flat, while the body runs caudo-medially and ends in a rounded tail of the epididymis. The tail of the epididymis continues as the ductus deferens. Both the proper ligament of the testis and the ligament of the tail of the epididymis are prominently developed. This study provides valuable insights into the anatomy of the testes and epididymis of Mandya breed ram.

Keywords: Bandur, Bannur, epididymis, Mandya ram, Morphometry, testes

Introduction
The Mandya sheep breed as the name suggests it is traditional to the Bandur village of Malavalli taluk of Mandya district of Karnataka state. 'Bannur' and 'Bandur' are commonly used synonyms for this breed (Fig. 1). This breed is well known for its superior meat quality (Fig.1) (Jain *et al.*, 2005) [14]. The testis is the site of production of the male gametes and testosterone hormone. The testicular measurements were increased with the advancement of age and body weight. The size and weight of left testis were higher than that of right testis at the same age. Semen volume and sperm concentration were highly significant and positively correlated with almost all testicular measurements (Kabiraj *et al.*, 2011) [1]. Epididymis is a highly convoluted tubule between the testis and the ductus deferens which performs a variety of important functions like sperm storage, maturation and transportation. The study of the testes and epididymis of different sheep breed were recorded in Hassan ram (Naik *et al.*, 2023) [2], Uda ram (Mahmodi *et al.*, 2017) [3], Duhok province ram (Sofi, 2022) [5], West African Dwarf Buck (Raji *et al.*, 2015) [6], Pabna region rams (Ahmmad *et al.*, 2015) [7], Bangladeshi rams (Boukhliq *et al.*, 2018) [4] whereas, meagre reports are available on Mandya rams. Hence the present work was undertaken to explore the morphological and anatomical data on the testis and epididymis of Mandya ram, which may provide insights on conservation efforts & reproduction.

Materials and Methods
A total of six pair of testes and epididymis samples were collected from adult rams of the Mandya sheep breed immediately after slaughter from local slaughter houses in and around Bandur village, Malavalli Taluk, Mandya District of Karnataka. The determination of age of the rams were ascertained based on the eruption of teeth (Noden and de Lahunta, 1985) [8]. The six genitalia of the rams were gently and precisely dissected for morphometric observations and immediately the samples were washed thoroughly in normal saline and

collected for gross anatomical studies. The length and width of the testis and epididymis were recorded using a Vernier calliper, non-absorbable thread and measuring scale the weight of testes were recorded by digital weighing machine (Fig. 4, Fig. 5). Statistical analysis were performed by using SPSS software.

Results and Discussion

Gross anatomy and morphometry of Testes

The testicles of Mandya ram were oriented vertical to long axis of the body and located a little in front of the inguinal region and are suspended by the spermatic cords in the pendulous scrotum similar to bull and goat as recorded by Sisson (1975) [10] whereas, in stallion and dog testicles are suspended horizontally and obliquely, respectively (Nickel *et al.*, 1979) [9]. Testicles are paired, larger in size, irregularly elliptical and round to oval in shape. Similar findings were recorded in Hassan ram (Naik *et al.*, 2023) [2]. Testes are relatively larger in size in rams compared to the carnivores (Nickel *et al.*, 1979) [9].

Testis has two surfaces, two borders and two extremities. The lateral surface is convex and smooth covered with tunica vaginalis and the medial surface slightly flattened due to close contact with the scrotal septum. The cranial border is convex which is relatively free whereas, the posterior border is attached with epididymis called epididymal border. The dorsal extremity is rounded and has close contact with head of epididymis which is continuous with testis. The distal or ventral extremity which is also rounded and attached by the tail of the epididymis. The testicles were whitish red in colour, most of its surface is covered by the visceral layer of tunica vaginalis. This reflection leaves a portion of the testis uncovered, allowing entry for blood vessels and nerves from the spermatic cord. Beneath this layer lies the dense fibrous whitish capsule called the tunica albuginea (Fig. 2. And Fig. 4.) Similar observations were recorded by Mahmodi *et al.*, (2017) [3] in Uda ram, Sofi, (2022) [5] in Duhok province ram, Raji *et al.*, (2015) [6] in West African Dwarf Buck, Ahmmad *et al.*, (2015) [7] in Pabna region rams and Boukhliq *et al.*, (2018) [4] in Bangladeshi rams.

The mean weight, length, width and thickness of the right testicle of the Mandya ram was 104.87±0.64 g, 7.92±0.07, 3.10±0.04 and 2.82±0.04, respectively, while the left testicle was 104.95±0.67 gm, 7.93±0.06 cm, 3.10±0.03 cm and 2.82±0.03 cm, respectively. The mean paired testicular weight, length, width and thickness was 209.82±1.31 g, 15.85±0.13 cm, 6.20±0.07 cm and 5.64±0.06 cm, respectively (Fig. 4) (Table.1). The seasonal variation in the testicular size was predominantly observed in wild species and it is absent in domestic mammals (Nickel *et al.*, 1979) [9].

Gross anatomy and morphometry of Epididymis

The epididymis of adult mandya ram is elongated, curved and closely attached to the caudo-medial border of the testicle. It is connected to vas deferens. Epididymis is divided in to three parts viz, head, body and tail. The dorsal enlarged part is head of epididymis which is irregularly flat and oval shaped, it is closely attached and extends craniolaterally on dorsal extremity of testis. The body of the epididymis descends caudomedially along the testis and ends in the rounded tail which is directed slightly caudally and is visible and is easily palpable through the scrotum. The proper ligament of the testis and ligament of the tail of the epididymis are well developed. Tail of the epididymis continuous as ductus deferens (Fig. 3). This finding was similar in ruminants to that of Getty (1975) [10], Mc Donald (1989) [12] Hafez (2000) [11] and Islam (2001) [13].

The mean weight of the right epididymis of the Mandya ram was 10.12±0.11 g, while that of the left epididymis was 10.22±0.13 g. The mean paired epididymal weight was recorded as 20.34±0.24 g. The mean length of the right epididymis was 13.97±0.07 cm, whereas the left epididymis measured 14.02±0.06 cm. The mean paired epididymal length was found to be 27.99±0.13 cm (Fig. 5) (Table, 2). Ahmmad *et al.*, (2015) [7] observed in Pabna region rams that the mean weight of left epididymis and right epididymis was 11.65±0.17 gm and 11.41±0.13 gm, respectively. The mean length for the left epididymis and right epididymis was 19.58±0.18 cm and 19.53±0.15 cm, respectively which is numerically greater than that of the present work. These variations in the lengths of the epididymis were probably due to the breed, diet and topographical changes.

Table 1: Details of testicular measurements of Mandya Ram.

Sl. No.	Body weight of Mandya Ram (kgs)	Weight of testicle (gms)		Length of testicle (cms)		Width of testicle (cms)		Thickness of testicles (cms)	
		Right	Left	Right	Left	Right	Left	Right	Left
1	36	106.7	106.9	8.0	8.0	3.1	3.1	2.9	2.8
2	32	103.8	103.8	7.8	7.9	3.0	3.0	2.9	2.9
3	33	105.2	105.1	7.9	7.9	3.2	3.1	2.8	2.8
4	35	106.4	106.7	8.2	8.2	3.2	3.2	2.7	2.8
5	42	104.5	104.5	7.8	7.8	3.1	3.1	2.9	2.9
6	31	102.6	102.7	7.8	7.8	3.0	3.1	2.7	2.7
Mean ± SE	34.83±1.62	104.87±0.64	104.95±0.67	7.92±0.07	7.93±0.06	3.10±0.04	3.10±0.03	2.82±0.04	2.82±0.03

Table 2: Details of epididymal measurements of mandya ram

Sl. No.	Body weight(kgs)	Weight of epididymis(gms)		Total length epididymis(cms)	
		Right	Left	Right	Left
1	36	10.3	10.5	14	14.1
2	32	9.8	9.8	13.8	13.8
3	33	10	10.2	13.9	14
4	35	10.2	10.3	14.1	14.1
5	42	10.5	10.6	14.2	14.2
6	31	9.9	9.9	13.8	13.9
Mean ± SE	34.83±1.62	10.12±0.11	10.22±0.13	13.97±0.07	14.02±0.06

Fig 1: Photograph showing typical Mandya ram

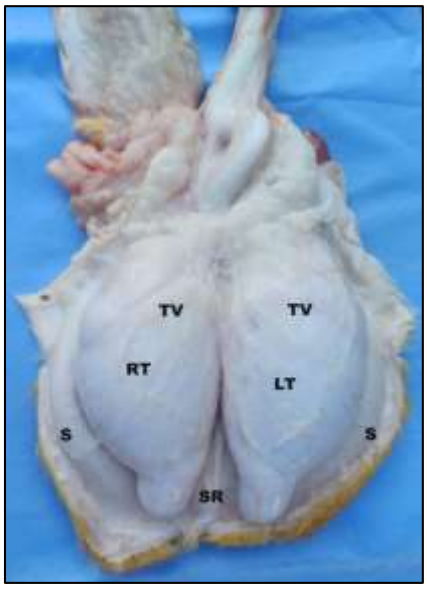

Fig 2: Photograph showing right (RT) and left (LT) testes located in scrotum (S), with covering of tunica vaginalis (TV) layer.

Fig 3: Photograph showing right (RT) and left (LT) testis along with firmly attached epididymis after separated from tunica vaginalis (TV) layer. Tunica albugenia (A), Head of epididymis (HE), Body of epididymis (BE), Tail of epididymis (TE) and Pampiniform plexus (PP).

Fig 4: Photograph showing measurement of length of testis after separated from epididymis.

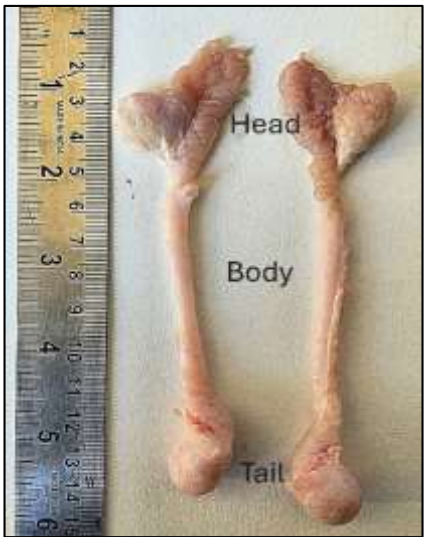

Fig 5: Photograph showing measuring length of right and left epididymis after separated from testis

Conclusion

The morphometric and gross anatomical details of paired testes and epididymis of Mandya Ram were almost similar in dimension, these parameters are of crucial in evaluating reproductive potential. Knowing the anatomical structure of the testes and epididymis including their shape, size are important factors for assessing semen quality and overall male reproductive health. Furthermore, changes in testicular morphology can be adopted to recognize potential difference in fertility among sheep breeds or within breeds.

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