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Gross anatomical studies on the rectum of goat (*Capra hircus*)

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Abstract
The present investigation was carried out on 10 rectums from recently slaughter adult goat. The rectum of the goat was tubular shape and situated in pelvic cavity. It was dorsally and laterally related to the pelvic wall. Ventrally it was related with urinary bladder, vasa differentia, seminal vesicles, prostate, pelvic part of urethra and cowper's gland in male and uterus and vagina in female. It had two surfaces: inner and outer surface. The outer surface of rectum was darker than inner surface and inner surface showed longitudinal mucosal folds. Externally rectum may be divided into two parts, peritoneal and retroperitoneal. Peritoneal part of rectum attached to pelvic cavity by mesorectum and retroperitoneal part of rectum attached by connective tissue and muscular bands. The average length was 12.75±0.42 cm, diameter 2.42± 0.08 cm at cranial, 2.97± 0.07 cm at middle and 2.49± 0.09 cm at caudal part and volume was 105.20 ± 3.32 ml.

Keywords: Gross anatomy, goat, rectum

Introduction
The goat belongs to the bovidae family and the caprine subfamily, which means it is closely related to sheep. It is one of the oldest domesticated species of animal, with archaeological evidence indicating that it was first domesticated 10,000 calibrated calendar years ago in Iran. (Zeder and Hesse, 2000) [22].
Throughout most of the world, goats have been utilized for milk, meat, fur, and skins (Coffey *et al*., 2004) [3]. Goat intestine is used to manufacture "catgut", a substance that is still utilized for internal human surgical sutures.
Goat milk is beneficial for preventing cardiovascular disease, cancer, allergies, dengu and microorganisms, as well as for boosting immunity. Goat milk is advised for infants, old and convalescent people. (Zenebe *et al.*, 2014) [23]
A goat is usually known as a "poor man's cow." (Bhattarai, 2012) [2]. Goats are smaller than cows, have a higher adaptability to adverse conditions, are more durable, multi-functional, easy to maintain, and generate more offspring.
The study aimed to investigate structure of the rectum of goat to justify the importance and essentiality in the body.

Materials and Methods
The present research was carried out on the rectum of adult goat (Capra hircus). Gross Anatomical, Histological and Histochemical studies on the research samples were conducted in the department of veterinary anatomy, CVAS, RAJUVAS, Bikaner.
The 10 samples were utilized in achievement of present study on the rectum. The samples of rectum were collected from recently slaughtered adult goats which were free from any pathological condition of digestive system, from Municipal Slaughter House, Bikaner.

Gross anatomical examination
For the gross anatomical studies pelvic cavity was carefully dissected out in recently slaughtered adult animal and rectum procured out promptly and handled with great care. The measurements of the target organ for various physical parameters like length, diameter and volume of rectum were carried out. Length and diameter were measured with the help of measuring tape and volume of water measured with the help of measuring beaker. Diameter was measured at three different portions i.e., caudal, middle and cranial part of rectum.

Result and Discussion

Gross anatomical examinations

The rectum of goat was a tubular organ and whitish red in colour (Fig. 1 and 2). The finding was in partial harmony with the findings of Ranjan and Das (2021) [18] in rabbit. The result was in incongruity with findings of Sharma *et al.* (I984) [19] about that the rectum of sheep appeared as a widely dilated sac. It was opened into the anus caudally (Fig. 1). The result was agreement with Konig and Liebich (2014) [13] in horse, Ghazali *et al*. (2018) [5] in rabbit and Heryani *et al.* (2020) [9] in bali cattle.

There was no clear-cut line of demarcation between colon and rectum, descending colon opened into the rectum. Rectum was extended in a straight direction from the level of pelvic brim to the posterior opening of the alimentary canal i.e. anus. The result was in agreement with report of Raghavan (1964) [16] in ox, horse and dog, Konig and Liebich (2004) [13] in horse, Hussein (2010) in goat and Getty (2012) [7] in horse. The result was in partially agreement with report of Portilla *et al.* (2011) [4] in rabbit and Evans and Lahunta (2013) [6] in dog. Rectum was situated in pelvic cavity (Fig. 1 and 2). The findings of present study was in conformity with the reports of Sharma *et al.* (1984) [19] in sheep, Konig and Liebich (2004) [13] in horse, Parez *et al.* (2016) in camel and Ghazali *et al.* (2018) [5] in rabbit. The result was in disagreement with findings of Jit (1974) [12] noted that rectum in monkey was located in front of the 3rd or 4th caudal vertebra and 4-6 cm long. Keeping to the middle line, it descended first downwards, and then downwards and forwards, until it passed through the levator ani muscle, where it bent downwards and backwards into the anal canal which terminate at the anus and Portilla *et al.* (2011) [4] mention that the rectum was the last portion of the rabbit's digestive tract and It begins at the third sacral vertebral level, adapting itself to that osseous structure, and ending up at the third coccygeal vertebra. The rectum was dorsally situated to reproductive organs.

It was dorsally and laterally related to the pelvic wall. Ventrally it was related with urinary bladder, vasa differentia, seminal vesicles, prostate, pelvic part of urethra and cowper's gland in male and uterus and vagina in female (Fig. 3). The findings of present study were in accordance with Raghavan (1964) [16] in horse, Sharma *et al.* (1984) [19] in sheep and Ghazali *et al.* (2018) [5] in rabbit.

Externally rectum may be divided into two parts, peritoneal and retroperitoneal (Fig. 4 and 5). These findings resembled to that of Raghavan (1964) [16] in horse, Raney (1968) [17] in sheep, Podder and Murgatrayd (1976) in ferret, Smuts *et al.* (1987) [20] in camel, Heald and Moran (1998) in human, Konig and Liebich (2004) [13] in horse, Hussein (2010) in goat and Getty (2012) [7] in horse. The findings of the present study was in partially conformity with the reports of Vater and Maieral (2018) [21] in alpaca.

Peritoneal part of rectum attached to pelvic cavity by mesorectum and retroperitoneal part of rectum attached by connective tissue and muscular bands (Fig. 5). The results were close agreement with Raghavan (1964) [16] in horse and dog, Raney (1968) [17] in sheep, Konig and Liebich (2004) [13] in horse and Hussain (2010) in goat, Getty (2012) [7] in horse and Aronson (2016) [1] in dog.

Rectum had two surfaces: inner and outer surface. The inner and outer surfaces of the rectum were different. The outer surface of rectum was darker than inner surface.

Longitudinal mucosal folds were present on the inner surface of the rectum (Fig. 4). The findings of present study were in accordance with Poddar and Murgatroyd (1976) [15] in ferret, Smuts *et al.* (1987) [20] in camel, Agarwal *et al.* (2002) in rabbit and Ranjan and Das (2021) [18] In rabbit. The findings of present study were in discordance with Agarwal *et al.* (2002) in dog showed that rectum of dog did not exhibit any mucosal folds but showed about 60 to 110 nodular swellings in the mucosa of the whole rectum.

The average length of the rectum was 12.75±0.42 cm with ranged from 10 to 14.5 cm. The result was disagreement with Jit (1974) [12] noted that rectum in monkey was 4-6 cm long, Kotpal (1989) recorded the length of rectum in rabbit was 7.5 cm, Agarwal *et al.* (2002) measured length of rectum in dog that was 5.30 cm ± 0.64 cm, Getty (2012) [7] in horse in which length was about one foot (30 cm), Vater and Maierl (2018) [21] measured the length of rectum in Alpaca, that was 0.3-0.4 meter and Heryani *et al.* (2020) [9] measured the length of intestine in bali cattle, that was 50.00 cm.

The diameter of rectum ranged from 2.06 to 2.76 cm at the cranial part, 2.54 to 3.34 cm at middle part and 2.06 to 2.98 cm at caudal part. The result was disagreement with Vater and Maierl (2018) [21] in Alpaca diameter was 3.5 cm and Heryani *et al.* (2020) [9] measured the length of intestine in bali cattle, that was 36.78 cm, 371.21, 50.00 cm cecum, colon and rectum respectively while the width was 9.65 cm, 11.47 cm, and 8.85 cm. The volume of rectum ranged from 90 to 120 ml with an average of 105.20 ± 3.32 ml.

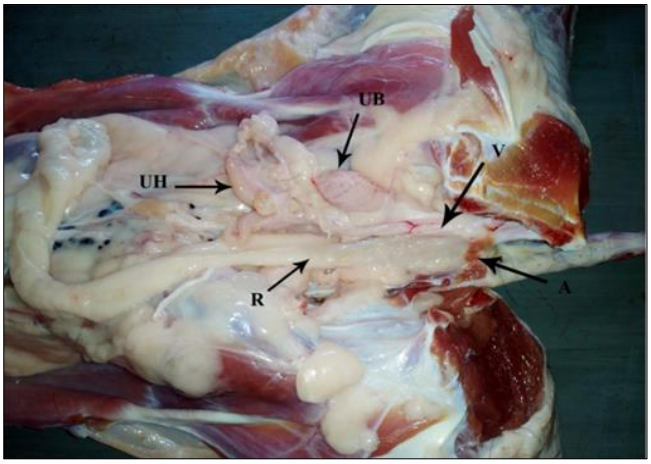

Fig 1: Photograph of in situ attachment of rectum of goat showing, A- Anus, R- Rectum, UH- Uterine horn, UB – Urinary bladder and V - Vagina.

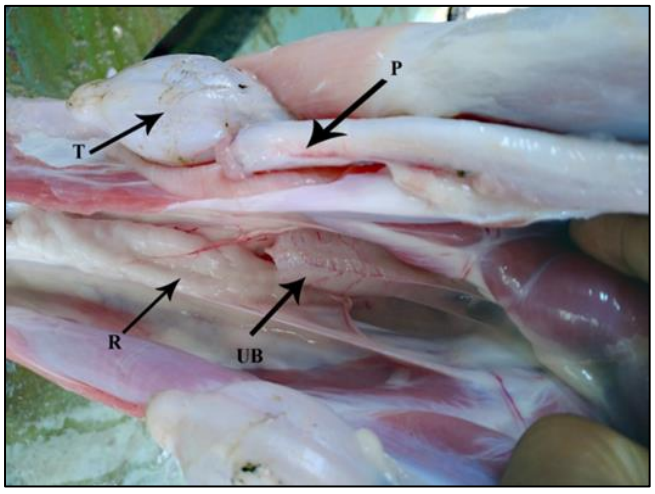

Fig 2: Photograph of in situ attachment of rectum of goat showing, R- Rectum, UB - Urinary bladder, T- Teste and P - Penis.

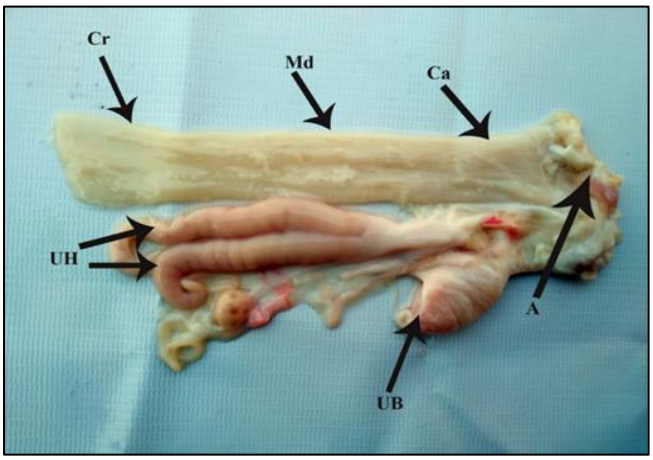

Fig 3: Photograph showing topography of rectum UB- Urinary bladder, UH- Uterine horn, Cr- Cranial end, Md- Middle end and Ca- Caudal end and A- Anus,

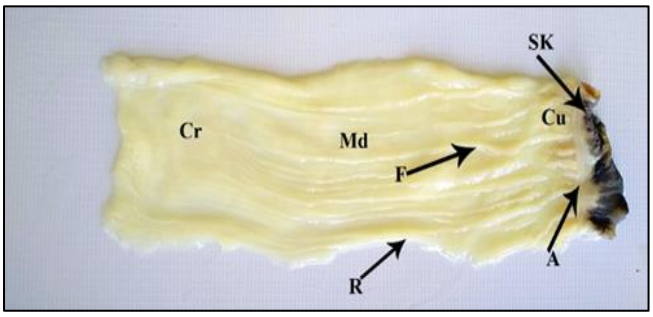

Fig 4: Photograph showing internal surface of rectum of goat. R- Rectum, F- Folded mucosa, SK- Skin, Cr- Cranial end, Md- Middle end and Cu- Caudal end

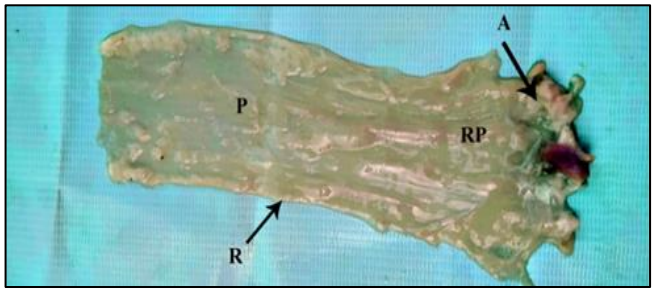

Fig 5: Photograph showing external surface of rectum of goat R- Rectum, A- Anus, RP- Retroperitoneal and P- Peritoneal.

Conclusion

The rectum of goat was a tubular organ. It was whitish red in colour and opened into the anus caudally. Rectum was situated in pelvic cavity. Externally rectum may be divided into two parts, peritoneal and retroperitoneal.

Rectum had two surfaces: inner and outer surface. The outer surface of rectum was darker than inner surface. Longitudinal mucosal folds were present on the inner surface of the rectum.

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