

Anatomical and histological structure of cervix uteri, corpus uteri and cornu uteri of the Anatolian wild goat

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ABSTRACT

Objective: This study aimed to determine the anatomical and histological structure of the uterus of the Anatolian wild goat.

Materials and Methods: Measurements were taken from the uterine segments using digital callipers. The animal material consisted of three wild goats of similar ages (2-3 old). The uterus was studied in three sections: Corpus uteri, cornu uteri and cervix uteri. Each section was examined anatomically and histologically.

Results: The mean length of cervix uteri was 33.99±1.22 mm, width of the cervix uteri was 13.39±0.92 mm, thickness of the cervix uteri was 8.42±1.68 mm and weight of the cervix uteri was 5.45±0.80 g. The mean corpus uteri length was 29.61±5.14 mm, corpus uteri width was 21.22±1.98 mm, corpus uteri thickness was 9.05±1.45 mm and corpus uteri weight was 4.30±0.77 g. The mean cornu uteri length was 41.34±8.02 mm, the cornu uteri width was 12.49±2.59 mm, the cornu uteri thickness was 6.73±0.86 mm and the cornu uteri weight was 5.46±0.31 g. Histologically, the uterine tissue was consist of three different regions, namely, cervix uteri, corpus uteri and cornu uteri also this parts were composed of endometrium, myometrium and perimetrium layers were located from the inside to the outside.

Conclusion: The findings of this study related to the Anatolian wild goat, which contributes to the wildlife diversity in Turkey, however, the population of which has been decreasing due to illegal and uncontrolled hunting or traffic accidents in recent years.

Keywords: Anatomy, Anatolian wild goat, Histology, Uterus

INTRODUCTION

Goats are mammals that make up the *Capra* genus of the *Bovinae* family. The mountain goat (*Capra*) is a genus that includes nine species. The domestic goat (*Capra aegagrus hircus*) is a domesticated subspecies of wild goats (Albayrak *et al.*, 2007). The wild goat, spreading in some countries of the Caucasus and the Middle East in the world, can be found in the Aegean, Mediterranean, Southeastern

Anatolia, Eastern Anatolia and Black Sea regions up to 4000-4500 m above sea level (Pellicena, 2014).

The cervix, corpus and cornu uteri are the three parts of the uterus (Budras and Wünsche, 2009; Popesko, 2010). The cervix uteri is a curved, muscular organ with a thin canal in the middle that connects the corpus uteri to the vagina. The anatomy, length and width of the cervix uteri varies among mammals. The mucosa of the cervix canal

(tunica mucosa) has branched folds (plica) extending towards the canal cavity (Alaçam, 2005). These plicas are plica circulares in ruminants. The canalis cervicis uteri is the gateway between the ostium uteri externum and the ostium uteri internum (König and Liebich, 2015). The vaginal protrusion of the ostium uteri externum can be found in many different shapes including, slit, bud (papilla), cover, duckbill, rose (Kershaw *et al.*, 2005), spiral, rosette (Naqvi *et al.*, 2005), star, bunch, tuber (Dayan *et al.*, 2010). The type of the shape vary according to age. While sheep generally have a rose shaped ostium uteri externum, lambs have been reported to have papilla shaped (Kershaw *et al.*, 2005). The corpus uteri is the part of the uterus that lies between the origin of the cornu uteri and the cervix uteri. Cornu uteri are cylindrical, curved, arc-shaped tubular formations located in the cavum abdominis, extending forward from the cranial of the corpus uteri (Semacan *et al.*, 2012; Bahadır and Yıldız, 2014). In the ruminants, the uterus is composed of three layers, namely, the endometrium, myometrium and perimetrium, starting from the lumen. It has been reported that the endometrium is composed of five different regions: surface epithelium, capillary surface, stratum compactum, stratum spongiosum and stratum basale (Agrawal and Bhattacharya, 1980; Bhattacharya and Saigol, 1984; Budras and Wünsche, 2009). It has been stated that prismatic epithelial uterine glands are located under the epithelial layer in which the cilium and cilium-free prismatic epithelium are located on the surface of the endometrium (Trautmann and Fiebiger, 1957; Salih and Abbas, 2014). The myometrium layer consisting of circular, inner vascular and longitudinal muscles the perimetrium constituted the outer most layer of the uterine wall (Agrawal and Laloraya, 1978).

The aim of the present study was to investigate the anatomical and histological structure of the uterus (cervix, corpus, cornu uteri) of the Anatolian wild goat (*Capra aegagrus aegagrus*) living in the Caucasus and North Anatolia Region. For the continuation of life, it is essential that zygote be formed and the embryo clings to the uterus wall. Cervix uteri is a difficult barrier to be used in artificial insemination applications. For these reasons, it was inevitable to study an extinct type of uterus.

MATERIALS and METHODS

The necessary permissions were obtained from the General Directorate of Nature Conservation and National Parks (21264211-288.04 / E.3790788) of the Ministry of Agriculture and Forestry to carry out this study. The animal material consisted of three wild goats of similar ages (2-3 old) that had been brought to the Kafkas University Wildlife Rescue and Rehabilitation Center for various reasons (traffic accidents, firearm injuries) and could not be saved despite all interventions.



Figure 1. The study material

The uterine material seen in Figure 1 was dissected and photographed using the Kodak Easyshare M320 Digital Camera (Eastman Kodak Company, Rochester, NY, USA) during necropsy while preserving the anatomical structure. *Nomina Anatomica Veterinaria* (2017) was used for naming the anatomical structures. The uterus was studied in three sections: corpus uteri, cornu uteri and cervix uteri. The cervix uteri length was measured from the ostium uteri internum to the ostium uteri externum. Corpus uteri length was measured from the junction of the two cornu uteri to the ostium uteri internum. The length of cornu uteri was measured from the cornu uteri junction to the tubouterinal junction. The measurements were taken from the uterine segments using digital callipers (stainless steel 1- to 150-mm). The weights of the uterine segments were measured on a precision scale (min: 0.0001 g–max: 220 g, code: XB220A, Precisa®, Swiss). The mean and standard error values of all measurements obtained were examined in the SPSS (version 20.0) packaged software program. For the histological examination of the uterine tissue, the tissues were fixed with 10% formol-aldh and routine histological tissue follow-up was performed. After being processed through graded alcohols and polished, the fixed blocks were embedded in paraffin. 5 µm thick sections were

taken from the paraffin blocks and stained using Crossman's triple staining method. The stained and fixed samples were examined under a light microscope (Carl Zeiss Microscopy, Göttingen, Germany) and their photographs were taken.

RESULTS

Anatomical results

The portio vaginalis, the protrusion of the ostium uteri externum, one of the holes that shaped cervix uteri, was found to be rose-shaped in wild goats. As shown in Figure 2, the mean cervix uteri length was 33.99 ± 1.22 mm, cervix uteri width was 13.39 ± 0.92 mm, cervix uteri thickness was 8.42 ± 1.68 mm and cervix uteri weight was 5.45 ± 0.80 g (Table 1).

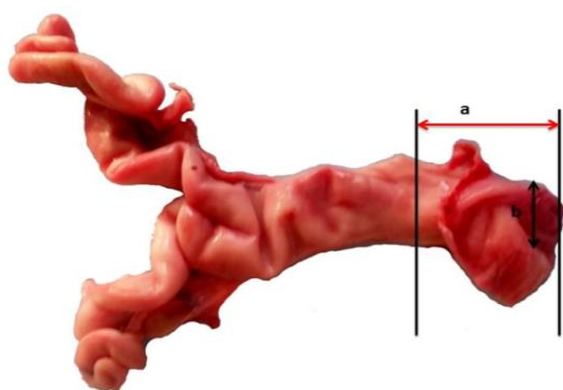


Figure 2. Measurements taken over cervix uteri and the rose shaped portio vaginalis. (a: Length of cervix uteri, b: Thickness of cervix uteri)

Table 1. Some values taken from the cervix uteri of the Anatolian wild goat.

Measurement	Mean±SE
Length of cervix uteri (mm)	33.99 ± 1.22
Width of cervix uteri (mm)	13.39 ± 0.92
Thickness of cervix uteri (mm)	8.42 ± 1.68
Weight of cervix uteri (g)	5.45 ± 0.80

SE: Standart error

We measured the mean length and thickness of corpus uteri as shown in Figure 3, 29.61 ± 5.14 mm, 9.05 ± 1.45 mm and corpus uteri weight was 4.30 ± 0.77 g. The mean corpus uteri width was 21.22 ± 1.98 mm and corpus uteri weight was 4.30 ± 0.77 g (Table 2).

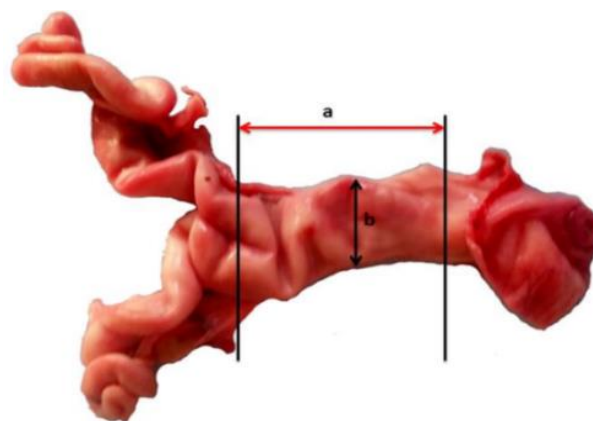


Figure 3. Measurements taken from the corpus uteri.

(a: Length of the corpus uteri, b: Thickness of the corpus uteri)

Table 2. Some values taken from the corpus uteri of Anatolian wild goat.

Measurements	Mean±SE
Length of corpus uteri (mm)	29.61 ± 5.14
Width of corpus uteri (mm)	21.22 ± 1.98
Thickness of corpus uteri (mm)	9.05 ± 1.45
Weight of corpus uteri (g)	4.30 ± 0.77

SE: Standart error

As shown in Figure 4, the average cornu uteri length was 41.34 ± 8.02 mm, cornu uteri width was 12.49 ± 2.59 mm, cornu uteri thickness was 6.73 ± 0.86 mm and cornu uteri weight was 5.46 ± 0.31 g (Table 3).

The macroanatomic examination revealed no ligamentum intercornule.

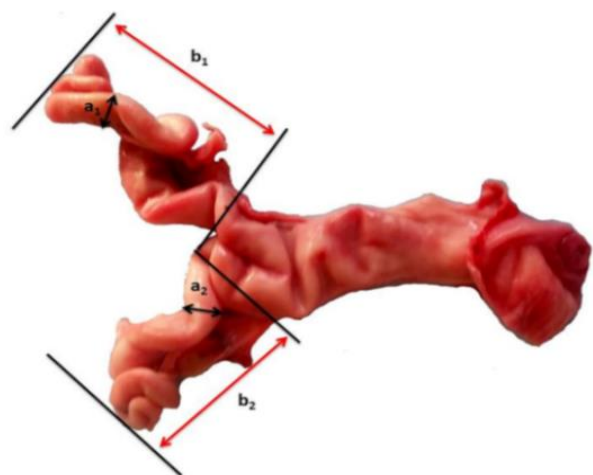


Figure 4. Measurements taken from the cornu uteri. (a₁, a₂: Thickness of the cornu uteri, b₁, b₂: Length of the cornu uteri)

Table 3. Some values taken from the cornu uteri of the Anatolian wild goats.

Measurements	Right mean±SE	Left mean±SE	General mean±SE
Length of cornu uteri (mm)	42.60±9.78	40.42±6.50	41.34±8.02
Width of cornu uteri (mm)	13.12±2.63	11.87±2.60	12.49±2.59
Thickness of cornu uteri (mm)	6.80±0.95	6.78±0.81	6.73±0.86
Weight of cornu uteri (g)	5.03±0.34	5.95±0.67	5.46±0.31

SE: Standart error

Histological results

Histologically, the wall of cervix, corpus and cornu uteri were comprised of three different layers from within outwards; endometrium, myometrium and perimetrium.

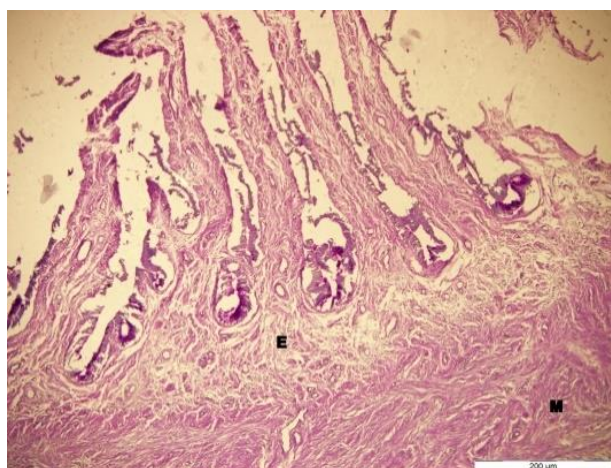
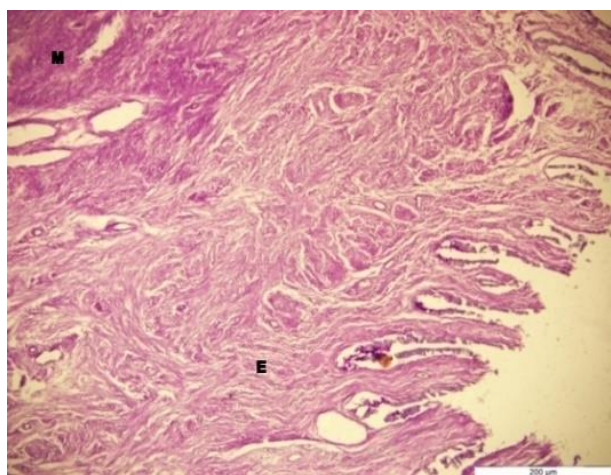


Figure 5. Triple staining of the Anatolian wild goat cervix uteri. Endometrium (E), myometrium (M).

The cervix uteri was the caudal most part of the uterus. We observed the cervix was thick walled, highly muscular and connective structure. It had a narrow lumen the canalis cervicis uteri. It was revealed that mucosa of cervix was thrown into several cervical crypts. The lining epithelium of

cervical crypts was pseudostratified columnar epithelium. The cervical glands were formed of the lining epithelium into the endometrium. The muscular layer of the cervix consisted of inner circular and outer longitudinal smooth muscle cells. The perimetrium comprised of connective tissue (Figure 5).

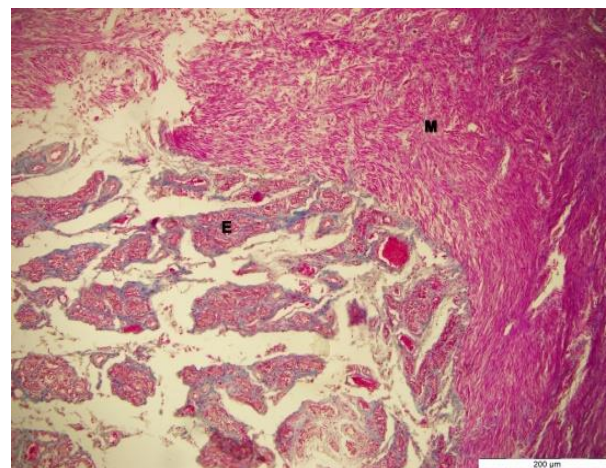
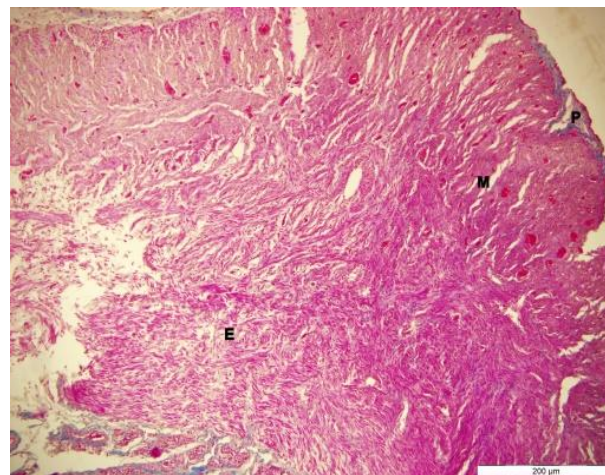


Figure 6. Triple staining of the Anatolian wild goat cornu uteri. Endometrium (E), myometrium (M), perimetrium (P).

It was determined that the corpus and cornu uteri consisted of pseudostratified columnar epithelium cells with cilium and non-cilium in places on the lumen-facing surfaces. Under these cells, the endometrium, which is rich in blood vessels and

endometrial glands, was found. The myometrium was composed of inner circular and outer longitudinal smooth muscle cells layers. These layers were followed by the perimetric layer consisting of connective tissue (Figure 6).

DISCUSSION

Harris (1962) and Zeuner (1963) reported that today's domestic goat is genetically involved in the domestication process of three wild goat species called bezoar (*Capra aegagrus*), markhor (*Capra falconeri*) and ibex (*Capra ibex*). It has been reported that *Capra aegagrus* main lines from the origin of the Turkey indigenous goat breeds (Cinar *et al.*, 2015). The age, species, physiological status, number of births given, etc. affect the length of the cervix uteri (Abiaezute *et al.*, 2017; Kershaw *et al.*, 2005). The shape of the ostium uteri externum, one of the holes that shapes the cervix uteri, was found to be rose shaped in sheep, papilla shaped in lambs (Kershaw *et al.*, 2005) and a bump in Ankara goats (Dayan *et al.*, 2010). When we compare the materials, we examined with the studies in the literature, it was the same as that of adult sheep (Kershaw *et al.*, 2005). The length of the cervix uteri has been reported to vary between 80-100 mm in ruminants (Budras and Wünsche, 2009). In a study by Gültiken *et al.* (2009) the length of the cervix uteri was reported to be 36.9±6.5 mm in Karakaya sheep and 28.9±3.5 mm in Karakaya lamb. In another study conducted by Naqvi *et al.* (2005), the cervix uteri length of sheep was determined as 53.00±1.5 mm, while this was determined as 38.00±1.2 mm for lambs. This value can vary between 30-40 mm in goats (Semacan *et al.*, 2012), 33.48±1.13 mm in Black Bengal goats (Gupta *et al.*, 2011), 21.9±4.9 mm in Gaddi goats (Shalini, 1997) and 25.9±6.1 mm in red Sokoto goats (Adigwe and Fayemi, 2005). In the present study, the length of the cervix uteri was determined as 33.99±1.22 mm. This value is compatible with the data obtained in the literature. This value was nearest to that of the Black Bengal goat. The width of the cervix uteri was 13.39±0.92 mm in Anatolian wild goats, while it was 10.7 ± 1.7 mm in red Sokoto goats (Gültiken *et al.*, 2009), 14.1±2.0 mm in Gaddi goats (Shalini, 1997), and 17.55±0.42 mm in Black Bengal goats (Gupta *et al.*, 2011). Cervix uteri width was also found to be among the determined reference values.

The mean corpus uteri length was reported as 20-40 mm in ruminants (Budras and Wünsche, 2009; Mahre *et al.*, 2016), 21.75±2.5 mm in sheep (Hyacinth

et al., 2016), and 20-30 mm in domestic goats (Semacan *et al.*, 2012). The findings of the present study are generally higher compared to those in the literature, however they are still within the maximum size limit. The corpus uteri width for red Sokoto goats was reported as 21.00±4.2 mm (Adigwe and Fayemi, 2005), while this length was determined as 21.22±1.98 mm for the Anatolian wild goats. The width of the cervix uteri obtained in the present study was found to be within the determined reference values.

Cornu uteri length has been reported to be 120-150 mm in domestic goats (Semacan *et al.*, 2012). In the present study, the mean length of the cornu uteri of Anatolian wild goats was determined to be 41.34±8.02 mm. The difference is a wavy structure of this difference was considered wild goat uterus and can vary depending on the age of the animals used. In the Rusa deer, the length of the left cornu uteri was 110±5 mm and the length of the right cornu uteri was 106±7 mm (Mahre *et al.*, 2016). In the wild goat, the mean length of the cornu uteri was 42.60±9.78 mm on the right side and 40.42±6.50 mm on the left side. Some studies have indicated that the left cornu uteri is longer than the right cornu uterus (Adigwe and Fayemi, 2005; Hyacinth *et al.*, 2016; Saleem *et al.*, 2017). In the present study, it was observed that the left cornu uteri was longer in two materials, while the right cornu uteri was longer in one material. In general, it was determined that the right cornu uteri was longer. In the Rusa deer, the left cornu uteri width is 15±5 mm, while the right cornu uteri width is 12 mm (Mahre *et al.*, 2016). Therefore, it can be said that the left cornu uteri is wider. However, in the wild goats the right cornu uteri was wider. When the relation between the length and width of cornu uteri in the Anatolian wild goats is observed, it can be said that there is a proportion between the two measurements. The absence of the ligamentum intercornuale in both the left and the right cornu uteri in ruminants was incompatible with the findings of this study, but similar to those found for Rusa deer (Mahre *et al.*, 2016).

CONCLUSION

In conclusion, it should not be forgotten that these findings of the Anatolian wild goat uterus, which are part of the diverse wildlife of Turkey but have decreased in terms of population due to uncontrolled hunting or traffic accidents in recent years, may be the first or last study. Studies on the

female genital system of Anatolian wild goat are limited (Kırbaş Doğan *et al.*, 2019). The results of the present study may contribute to future studies, when these animals, which are on the verge of becoming extinct (Anonymous, 2019) are taken under protection and propagated by artificial insemination.

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