

HISTOMORPHOLOGICAL STUDIES OF THE FEMALE REPRODUCTIVE ORGANS OF THE AFRICAN CANE RAT (*THRYONOMYS SWINDERIANUS*)

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ABSTRACT

This study was aimed at studying the histo-morphology of the reproductive organs of the female African cane rat (*Thryonomys swinderianus*). Twenty apparently healthy female African cane rats were obtained from a private farm in Apo area settlement of the Federal Capital Territory, Abuja, Nigeria. Age estimation was done using dentition and head to tail measurements, and animals acquired were estimated to be five months old. A ventral mid-line incision was made to expose the reproductive organs. Organs were fixed in 10% formalin after which sections were made and stained with H &E, Alcian blue and PAS. Results revealed predominance of primordial follicles, uterine glands, folded oviductal mucosa, and epithelial stratification in the vagina; PAS staining revealed the presence of neutral mucopolysaccharides within epithelial cells and basement membranes, while Alcian Blue staining demonstrated sparse acidic mucins, indicating early mucosal differentiation. These data offer a reliable reference for assessing reproductive health, diagnosing abnormalities, and optimizing breeding strategies in grasscutter domestication programs. Such foundational knowledge is critical for the sustainable utilization of this species as an important protein source in sub-Saharan Africa.

Keywords: African cane rat; histology; ovary; oviduct; uterus; vagina

INTRODUCTION

The African cane rat (*Thryonomys swinderianus*), commonly known as the grasscutter, is a large hystricomorph rodent widely distributed across sub-Saharan Africa. It inhabits grasslands, farmlands, and wetland margins where abundant vegetation supports its predominantly herbivorous diet (van Zyl *et al.*, 2005). In recent years, the species has attracted significant attention as a source of animal protein due to its high meat quality, favorable growth characteristics, and adaptability to captivity, which have contributed to increasing domestication efforts in West Africa (Durowaye *et al.*, 2021). These attributes have stimulated scientific interest in its biology, particularly aspects of reproductive development essential for sustainable breeding programs.

The female reproductive system of mammals undergoes notable structural and functional transitions from birth through sexual maturity. During the juvenile period,

reproductive organs progressively develop through tissue differentiation, epithelial maturation, and early glandular formation in preparation for reproductive activity (Oduor Okelo, 1978; El Gendy *et al.*, 2016). Understanding these early developmental events is important for distinguishing normal physiological immaturity from pathological alterations and provides a baseline for reproductive health assessment in emerging micro-livestock species such as *T. swinderianus*.

Histomorphological assessment remains one of the fundamental approaches for studying reproductive development. Routine staining techniques such as Hematoxylin and Eosin (H&E) allow visualization of general tissue architecture, including epithelial lining, stromal components, and early follicular patterns (Junqueira & Carneiro, 2015; Dellmann & Eurell, 2018). Special histochemical stains such as Periodic Acid–Schiff (PAS) and

Alcian Blue are valuable for demonstrating neutral and acidic mucopolysaccharides, respectively—key components of epithelial secretions and extracellular matrices within the reproductive tract (Kiernan, 2015; Al-Saffar & Al Ebbadi, 2019). These techniques provide deeper insight into tissue functionality and secretory patterns during early reproductive development.

Despite the growing importance of *T. swinderianus* in local livestock systems, available literature remains limited regarding the histomorphology and histochemical characteristics of its juvenile female reproductive organs. Prior studies have largely focused on adult anatomy (Adebayo *et al.*, 2009; Ajayi *et al.*, 2010) or on unrelated organ systems such as the alimentary canal or the thyroid gland (van Zylet *et al.*, 2005; Igbokwe, 2010). Consequently, there is a critical need for foundational microanatomical data on the juvenile reproductive tract. This study therefore addresses this gap by providing detailed histomorphological and histochemical descriptions of the ovary, oviduct, uterus, and vagina in juvenile female African cane rats.

Although several studies have described the reproductive anatomy of adult female African cane rats, a clear information on the histology of female reproductive organs is limited. Most available reports emphasize gross anatomy, leaving a knowledge gap regarding the histo-morphology.

The absence of baseline histomorphological data limits accurate interpretation of reproductive development, creates challenges in identifying abnormalities.

The aim of this study was to study the histomorphological features of the ovary, oviduct, uterus, and vagina of female African cane rats using Hematoxylin and Eosin (H&E), Periodic Acid-Schiff (PAS), and Alcian Blue staining techniques.

MATERIALS AND METHODS

ANIMAL PROCUREMENT AND MANAGEMENT

Twenty apparently healthy female African cane rats of 5 months of age were procured from a private farm at Apo, Abuja, Nigeria, and transported to the research laboratory in the Department of Veterinary Anatomy of Joseph Sarwuan Tarka University

ETHICAL CONSIDERATION

An approval was sought and obtained from the animal care and ethical committee of the College of Veterinary Medicine, Joseph Sarwuan Tarka University Makurdi. This research was conducted in the Histology Laboratory of the Department of Veterinary Anatomy, Joseph Sarwuan Tarka University (JOSTUM), Makurdi, Benue State, Nigeria.

HISTOLOGICAL PROCESSING

Tissues from the ovary, oviduct, uterus, and vagina were fixed in 10% neutral buffered formalin, processed through graded alcohols, cleared in xylene, and embedded in paraffin wax. Sections (5µm thick) were cut and stained with Hematoxylin and Eosin (H&E) for general tissue architecture, Periodic Acid-Schiff (PAS) for neutral mucins and glycoproteins and Alcian Blue (pH 2.5) for acidic mucins. Sections were examined under a light microscope and photographed at ×100 magnification.

RESULTS

Microscopic examination of the vagina revealed mucoid secreting epithelial lining surrounded by loose connective tissue stroma (Figure I). The endometrium showed developing glands lined by columnar epithelium, surrounded by dense connective tissue, smooth muscle layers, and blood vessels; nests of granulosa cells, mature oocytes, and numerous Graafian follicles were observed (Figure II)

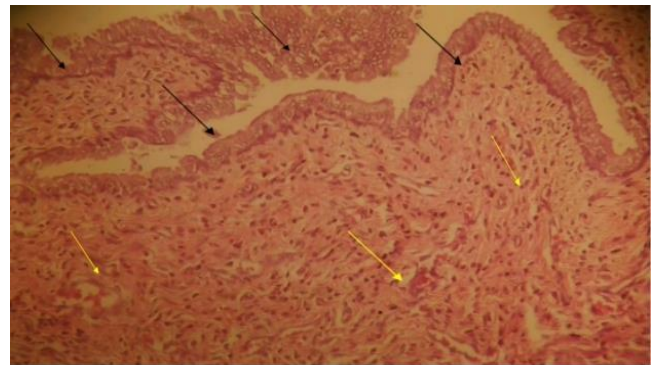


Figure I: Photomicrograph of the uterus showing endometrial glands (black arrows) lining of the endometrium, surrounded by dense connective tissue, muscle and blood vessels (yellow arrows). Normal features seen. Haematoxylin and eosin stain; x100.

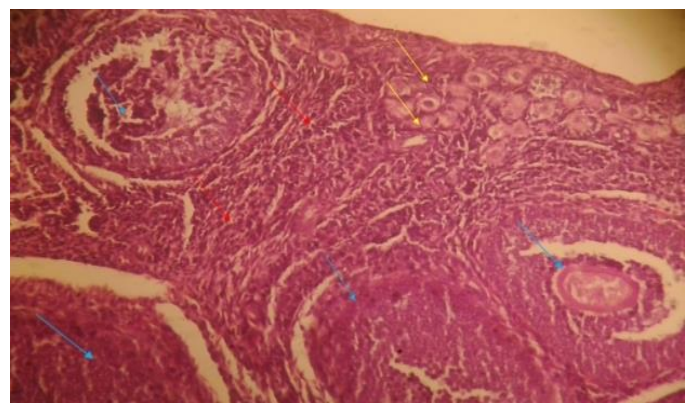


Figure II: Photomicrograph of ovary showing nests of granulosa cells (red arrows) with mature oocyte (blue arrows) and numerous Graafian follicle (yellow arrows). Haematoxylin and eosin stain; x100.



Figure III: Photomicrograph of the oviduct showcasing lining epithelial of duct (black arrows), surrounded by stromal cells (yellow arrows) and muscle (blue arrow). Haematoxylin and eosin stain; x100.

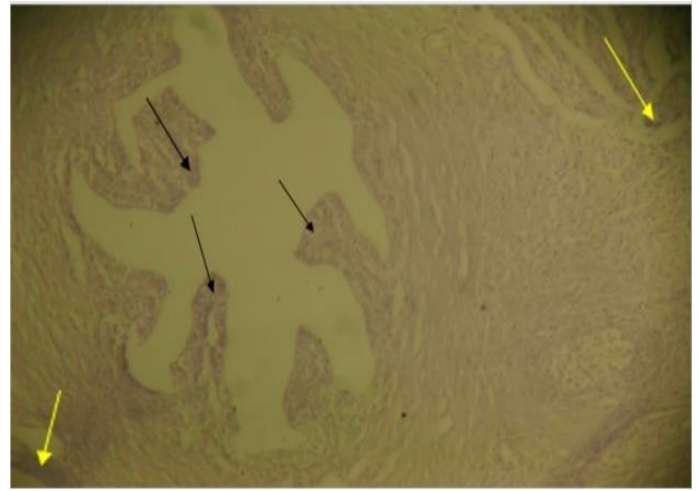


Figure V: Showing moderate magenta stained columnar glands (black arrows) of the fallopian tube structure and the surrounding ducts (yellow arrows). Periodic Acid Schiff stain; x100.

PERIODIC ACID-SCHIFF (PAS) REACTION

Moderate PAS-positive (magenta) staining was observed at the apical regions of epithelial cells in the oviduct, uterus, and vagina, indicating early synthesis of neutral mucins and glycoproteins associated with secretory maturation. Basement membranes stained distinctly, clearly separating epithelium from stroma. In the vagina, faint to moderate staining of hyperplastic epithelial cells was observed. In the ovary and oviduct, moderate staining in glandular/ductal structures was observed, while in the uterus, moderate staining of endometrial glands was observed.

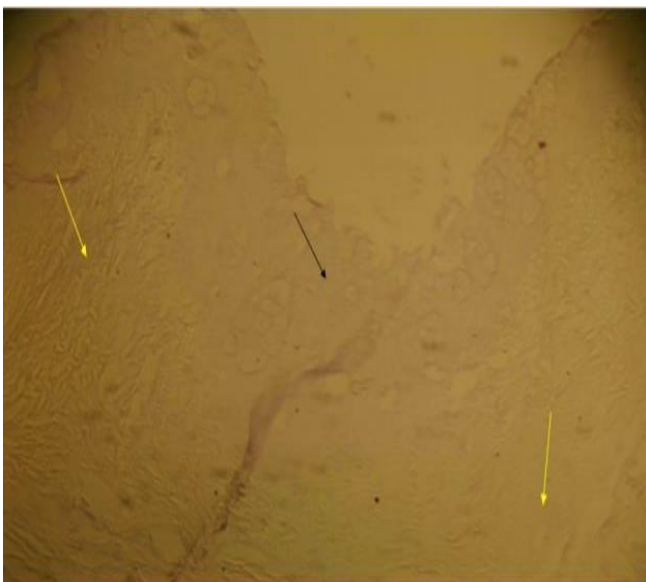


Figure IV: Showing faintly magenta stained hyperplastic epithelial cells (black arrow), surrounded by connective tissue stroma (yellow arrows). Periodic acid Schiff stain; x100.

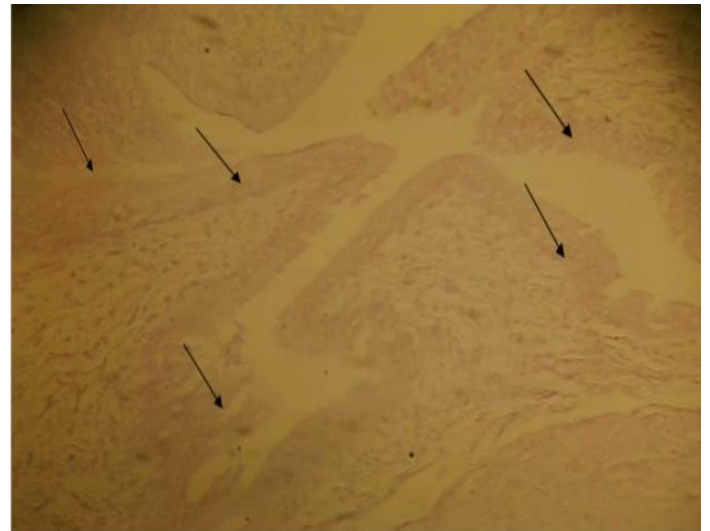


Figure VI: Moderately staining endometrial glands (black arrows), indicative of neutral or alkaline mucin secretion. Periodic acid Schiff stain; x100.

ALCIAN BLUE REACTION

Mild, patchy Alcian blue positivity was noted in some epithelial cells, indicating low-level acidic mucin production consistent with early functional maturation. Non-staining or faint areas suggested predominant neutral/alkaline mucin secretion. In the vagina and uterus, faint staining in glandular epithelium was observed, while in the oviduct, mostly non-reactive ducts, with faint positivity in select glandular structures were observed.

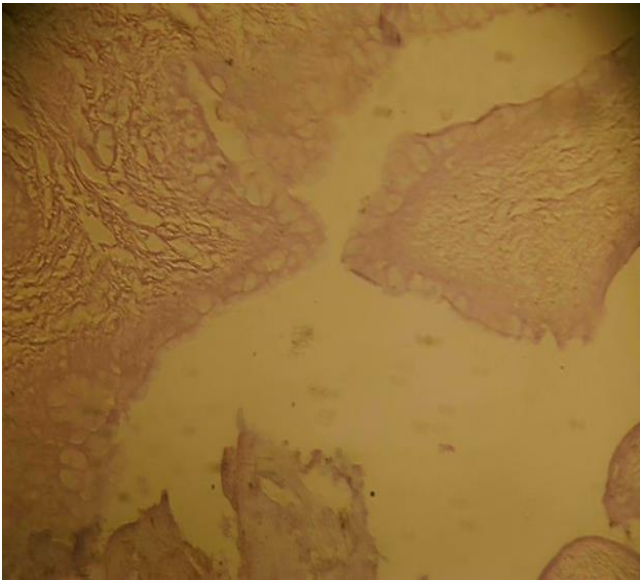


Figure VII: Faintly staining glandular epithelial cells (black arrows), indicative of less neutral or alkaline mucin secretion by the glands; Periodic acid Schiff stain; x100.

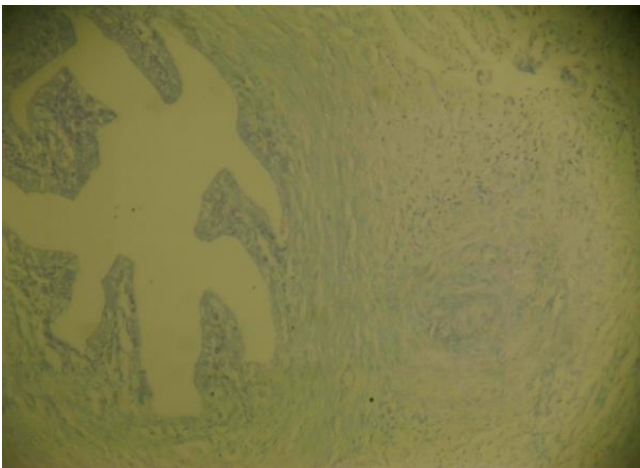


Figure VIII: Showing faintly stained glandular structures of the fallopian fenestrations (black arrows) and ducts (yellow arrows), suggestive of low acidic glandular secretions. Alcian Blue stain; x100.



Figure IX: Faintly staining endometrial glands (black arrows). Suggestive of non-acidic secretions, hyperplastic with no atypia or neoplasm. Alcian Blue stain; x100.

DISCUSSION

This study provides descriptive histomorphological and histochemical characteristics of the female reproductive tract in 5-month-old juvenile African can rat. The presence of nests of granulosa cells, mature oocytes, and numerous Graafian follicles in the ovary indicates that follicular recruitment and growth are already well underway. This shows that ovaries are in an active peripubertal phase rather than a purely infantile stage. The animal appears to be approaching or entering the threshold of sexual maturity, suggesting that female grasscutters may become capable of reproduction from 5 months of age. This relatively early maturation pattern is quite promising for domestication in that it implies a short generation interval and a quick breeding turnover.

Also, the histomorphological and histochemical features observed in the juvenile (5-month-old) female African can rat (*T. swinderianus*) is indicative of active but immature development of the reproductive tract, consistent with the peripubertal transition phase in hystricomorph rodents.

In the oviduct and uterus, developing endometrial glands and simple columnar epithelium with moderate PAS-positive (neutral mucin/glycoprotein) staining at the apical regions demonstrate early secretory differentiation. The predominance of neutral mucins over acidic mucins (weaker Alcian Blue) is typical of immature, non-cycling reproductive tracts before strong cyclic hormonal stimulation. The vagina showed mucoid-secreting epithelium, indicating early functional maturation for lubrication and microbial protection even before full sexual maturity.

Overall, at 5 months of age, the female reproductive organs of *T. swinderianus* exhibit coordinated but immature development. The reproductive tract is structurally organized, functionally progressing, and reproductively promising, with no observed pathological changes (inflammation, hypoplasia, neoplasia, or atypia).

The histomorphological features align with the peripubertal transition phase in hystricomorph rodents. The observation of Graafian follicles at 5 months is consistent with the histological description of the ovary in the African cane rat by Oduor-Okelo (1978). Female grasscutters reach sexual maturity around 6–8 months of age. Histological and breeding studies have shown that grasscutters are induced (reflex) ovulators, as corpora lutea are absent in non-mated females but present following mating (Addo *et al.*, 2002; Addo, 2007).

Moderate PAS-positive staining in the oviduct and uterus indicates early synthesis of neutral mucins and glycoproteins crucial for ciliary function, gamete transport, and embryo nourishment.

The low-level, patchy Alcian Blue positivity reflects nascent acidic mucin production typical of developing reproductive tracts before the establishment of full estrous cyclicity. These findings are consistent with age-related reproductive maturation patterns reported in male cane rats, where morpho-physiological parameters increase progressively from prepubertal to adult stages (Omirinde *et al.*, 2021). The oviduct showed a simple columnar epithelial lining supported by stromal cells and smooth muscle layers. Moderate PAS-positive staining at the apical regions of epithelial cells indicates early synthesis of neutral mucins and glycoproteins, which are crucial for ciliary function, gamete transport, and embryo nourishment in later reproductive life. The low-level, patchy Alcian Blue positivity reflects nascent acidic mucin production typical of developing reproductive tracts before the establishment of full estrous cyclicity (Lagow *et al.*, 1999).

In the uterus, developing endometrial glands surrounded by dense connective tissue and myometrium represent normal glandular differentiation. Moderate PAS reactivity in these glands suggests preparation for secretory activity essential for implantation and pregnancy maintenance. The faint Alcian Blue staining is consistent with predominant neutral mucin secretion at this juvenile stage, a pattern observed in many mammalian species during early reproductive maturation (Russell, 2015).

The vagina exhibited a mucoid-secreting epithelial lining supported by loose connective tissue. This feature, along with faint to moderate mucin staining, indicates early functional differentiation of the vaginal mucosa for lubrication and protection, even prior to full sexual maturity. Such mucoid activity is important in hystricomorph rodents, many of which possess a vaginal closure membrane that perforates at puberty (Addo *et al.*, 2007).

These collective findings demonstrate that at 5 months of age, the female reproductive organs of *T. swinderianus* are structurally organized and beginning to acquire functional secretory capabilities, though not yet exhibiting the pronounced cyclic changes characteristic of adults. This timeline is consistent with age-related reproductive maturation patterns reported in male cane rats, where morphophysiological parameters (e.g., seminiferous tubule development and hormonal profiles) increase progressively from prepubertal to adult stages. (Omirinde *et al.*, 2021).

The results from this study addresses a significant knowledge gap, as most previous studies on the grasscutter reproductive system have focused on gross anatomy of adults or reproductive performance in captivity (Addo *et al.*, 2002; Ibe *et al.*, 2023). The histochemical baselines using H&E, PAS, and Alcian Blue offer a valuable reference for distinguishing normal developmental features from pathological conditions in captive breeding populations.

CONCLUSION

This study provides the first detailed histomorphological and histochemical baseline of the juvenile female reproductive tract in *Thryonomys swinderianus*. The organs exhibit active but immature features, including follicular development and early mucin secretion. These data offer a reliable reference for assessing reproductive health, diagnosing abnormalities, and optimizing breeding strategies in grasscutter domestication programs. Such foundational knowledge is critical for the sustainable utilization of this species as an important protein source in sub-Saharan Africa.

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