

HISTOMORPHOLOGY OF OVIDUCT IN ADULT RAJASRI FOWL

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ABSTRACT

The present study was conducted on thirty-six (36) apparently healthy laying Rajasri fowls. The histomorphological characteristics of the oviduct were studied by using a light microscope, and it was divided into five regions, i.e., infundibulum, isthmus, magnum, uterus, and vagina. The wall of oviduct was composed of tunica mucosa, lamina propria sub mucosa, tunica muscularis and tunica serosa from inside to outside. The length of mucosal folds was more in the magnum was $2268.87 \pm 424.22 \mu\text{m}$ and least in the infundibulum with $419.62 \pm 94.28 \mu\text{m}$ while the thickness of tunica muscularis was more in the vagina ($418.56 \pm 36.15 \mu\text{m}$) and less in the isthmus ($196.09 \pm 62.38 \mu\text{m}$).

Keywords: Histology, Oviduct, Rajasri fowl

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The “Rajasri” bird is a dual-purpose bird and has great potential due to its versatile capacity to adapt to various climatic conditions. The oviduct is a highly convoluted muscular tube that is suspended from the left side of the abdominal cavity by the dorsal and ventral oviductal ligament. Segments are responsible for synthesizing specific components of eggs, including the peri-vitelline membrane, egg yolk, albumin and eggshell. Additionally, the oviduct plays a critical role in transporting the ovum, depositing sperm and providing a storage site for eggs and fertilization. Therefore, the present work is undertaken to explore the histoarchitecture of the oviduct in laying Rajasri fowl.

MATERIALS AND METHODS

The present study was conducted on thirty-six (36) apparently healthy laying Rajasri fowls. The study was conducted in laying birds of the same age group ranging from 26 to 28 weeks. The oviducts were collected from these birds which were slaughtered in the Department of ILFC, Poultry Science of N.T.R College of Veterinary Science, Gannavaram and from local slaughter houses.

The tissue samples from different segments of the oviduct were fixed in 10% Neutral buffered formalin and Bouin's fluid (Singh and Sulochana, 1996). The fixed tissues were subjected to routine tissue processing and paraffin blocking and sections of $4-5 \mu\text{m}$ thickness, and the sections were stained by Haematoxylin and Eosin stains for routine histological study and Verhoeff's method for elastic fibres (Singh and Sulochana, 1996), Masson's Trichrome for collagen fibers, Wilder's method for reticular fibres and Bielschowsky's method for nerve fibers (Luna, 1968).

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The length of mucosal folds, height of epithelium, thickness of propria submucosa and thickness of tunica muscularis in different segments of oviduct was measured by using ocular and stage micrometer under light microscope. The data was subjected to the statistical analysis by using SPSS software.

RESULTS AND DISCUSSION

OVIDUCT

The tunica mucosa was determined to form a varied number of longitudinal folds protruding into the lumen in different segments of the entire oviduct (Fig. 1). The height, width and shape of these longitudinal folds were varied in different regions of the oviduct and the epithelium of this mucosa was also observed varying in different regions of the oviduct (Figs. 2 and 3). The lamina propria submucosa consisted of loose connective tissue with collagen, reticular, elastic fibres, nerve fibres and scattered blood capillaries (Figs. 4, 5 and 6). The tunica muscularis consisted of a thin outer longitudinal and thick inner circular layer of smooth muscle fibres and the thickness was varied in different regions of oviduct. The tunica serosa, which was the outermost layer, consisted of connective tissue fibres and was lined by simple squamous epithelium externally. These observations are in accordance with the findings of Gana *et al.* (2022) in adult normal feathered and naked-neck genotypes of Nigerian chickens.

INFUNDIBULUM

The tunica mucosa of anterior funnel part of the infundibulum was projected into mucosal folds which were lower in height when compared to the posterior part of infundibulum. These observations were in accordance with findings of Nabil *et al.* (2022) in laying turkey hens.

Contrary to this, Sharaf *et al.* (2012) noticed the mucosa of infundibular funnel gave short, broad and highly branched mucosal folds carrying secondary and some tertiary folds with short primary folds in laying Ostriches. The average length of mucosal fold was $419.62 \pm 94.28 \mu\text{m}$ (Table 1). The luminal epithelium was lined by simple columnar epithelium and consisted of non-ciliated cells, ciliated cells and goblet cells (Fig. 2). These observations are in accordance with findings by Mehta and Guha (2012) in both developing and laying hens and Patki *et al.* (2013) in the adult Kuttanad duck. The average height of the epithelium was $17.96 \pm 4.48 \mu\text{m}$ (Table 1).

The lamina propria submucosa was extended into the core of mucosal folds, but the tubular glands were absent (Fig. 7). It was vascularized and consisted of loose connective tissue with collagen, reticular and elastic fibres. Similar observations were noticed in adult turkey hens (Islam *et al.*, 2021). The tunica muscularis was well represented with inner circular and outer longitudinal smooth muscle layers (Fig. 7). Similar findings were noticed by Mehta and Guha (2012) in both developing and laying hens. The average thickness of the tunica muscularis was $208.7 \pm 28.62 \mu\text{m}$ (Table 1). The tunica serosa which was outermost layer was comprised of loose connective tissue and was lined by simple columnar epithelium (Fig. 7).

MAGNUM

In the magnum part of the oviduct, the tunica mucosa was thrown into the lumen and formed the tall and thick longitudinal mucosal folds (Fig. 8). The mucosal folds were leaf-like in shape and were longer in length when compared to the in fundibulum. The core of mucosal folds was formed by dense collagen and reticular fibres. These observations are in accordance with findings of Vijaykumar *et al.* (2016) in laying emu birds, Wani *et al.* (2017) in Kashmir faverolla chicken and Nabil *et al.* (2022) in laying Turkey hens. Contrary to the present findings, Paul *et al.* (2016) observed that the mucosal folds were comparatively shorter than other regions of the oviduct in the magnum of Sonali, Deshi and Hyaline chickens. The average length of mucosal fold in magnum was $2268.87 \pm 424.22 \mu\text{m}$ (Table 1). Contrary to this, Mahammadpour and keshtmandi (2008) in turkey and pigeon reported $1987.5 \pm 161.25 \mu\text{m}$ and $775.12 \pm 35.16 \mu\text{m}$, respectively. It was lined by pseudostratified ciliated columnar epithelium along with non-ciliated cells (Fig. 9). These ciliated and non-ciliated cells were prismatic and goblet in shape, respectively. These results were in accordance with the findings of Nabil *et al.* (2022) in laying Turkey hens. The average height of epithelium in

tunica mucosa was $28.87 \pm 8.86 \mu\text{m}$. The average thickness of propria submucosa was $472.69 \pm 69.71 \mu\text{m}$ (Table 1).

The tunica muscularis was clearly demarcated into inner thicker circular and outer longitudinal smooth muscle fibres (Fig. 8). These observations are in accordance with findings of Islam *et al.* (2021) in adult Turkey hens. The average thickness of tunica muscularis was $196.09 \pm 62.38 \mu\text{m}$ (Table 1).

ISTHMUS

The tunic mucosa of the isthmus segment showed longitudinal mucosal folds (Fig. 10). These folds were lower in height when compared to magnum (Graph-1). It was lined by pseudostratified columnar epithelium. The ciliation was present on the mucosal surface of epithelium (Fig. 11). Both the secretory goblet cells and non-secretory prismatic cells were observed in the epithelium. Similar findings were observed by Islam *et al.* (2021) in adult turkey hens whereas, Eurell and Frappier (2006) reported that the epithelium of isthmus was simple columnar in adult birds. The average length of mucosal fold and height of mucosal epithelium of isthmus was $1468.32 \pm 58.51 \mu\text{m}$ and $26.85 \pm 5.31 \mu\text{m}$, respectively (Table 1).

The tunica muscularis was clearly demarcated into inner circular and outer longitudinal smooth muscles (Fig. 10). The average thickness of tunica muscularis was $171.24 \pm 32.42 \mu\text{m}$ (Table 1). Contrary to this, Balash and Baghdady (2013) reported $600 \pm 2 \mu\text{m}$ thickness in turkey.

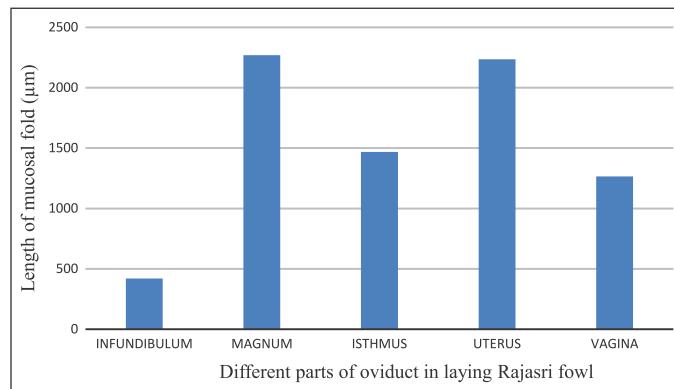
UTERUS

The tunica mucosa of the uterus was projected into longer and more complex mucosal folds than isthmus (Fig. 1). The mucosal epithelium was lined by pseudostratified epithelium with intermittent ciliated columnar cells. The ciliated cells contained secretory granules. Similar observations were noticed by Islam *et al.* (2021) in uterus of adult turkey hens and Nabil *et al.* (2022) in laying Turkey hens as in the present study. The average length of mucosal folds and height of epithelium were $2235.11 \pm 121.31 \mu\text{m}$ and $25.48 \pm 4.34 \mu\text{m}$ (Table 3). Contrary to this, Paul *et al.* (2016) in the uterus of Deshi, Sonali and Hyaline chickens noticed $1716.7 \pm 143.76 \mu\text{m}$, $1458.3 \pm 66.46 \mu\text{m}$ and $1416.7 \pm 408.25 \mu\text{m}$, respectively.

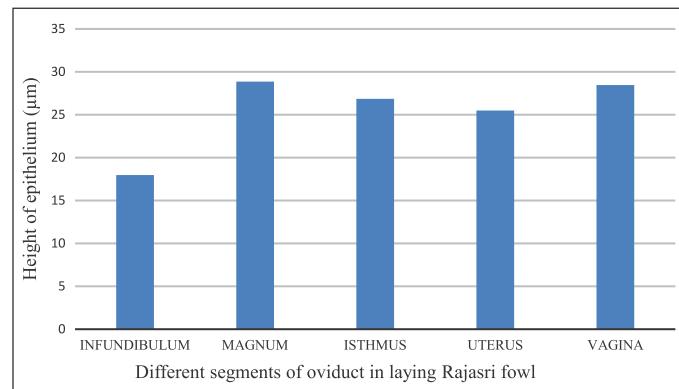
The lamina propria submucosa consisted of highly vascularized loose connective tissue with branched tubular glands. The tubular glands were densely packed and were separated from each other by collagen, reticular and nerve fibres. These observations are in accordance with findings of Islam *et al.* (2021) in uterus of adult turkey hens and Nabil *et al.* (2022) in laying Turkey hens. The tunica muscularis was thicker than the other parts of the oviduct

Table 1. The average micrometrical observations of different parts of oviduct in laying Rajasri fowl

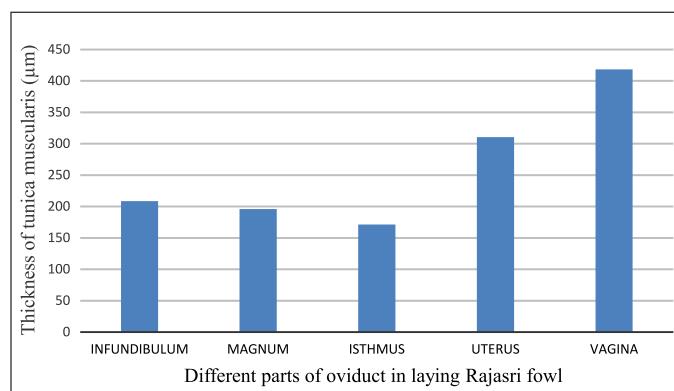
Part	Parameter	Laying Rajasri Fowl (Mean \pm S.E)
1. Infundibulum	Length of mucosal fold (μm)	419.62 \pm 94.28
	Height of epithelium (μm)	17.96 \pm 4.48
2. Magnum	Thickness of tunica muscularis (μm)	208.7 \pm 28.62
	Length of mucosal fold (μm)	2268.87 \pm 424.22
3. Isthmus	Height of epithelium (μm)	28.87 \pm 8.86
	Thickness of propria submucosa (μm)	472.69 \pm 69.71
4. Uterus	Thickness of tunica muscularis (μm)	196.09 \pm 62.38
	Length of mucosal fold (μm)	1468.32 \pm 58.51
5. Vagina	Height of epithelium (μm)	26.85 \pm 5.31
	Thickness of propria submucosa (μm)	386.46 \pm 63.32
	Thickness of tunica muscularis (μm)	171.24 \pm 32.42
	Length of mucosal fold (μm)	2235.11 \pm 121.31
	Height of epithelium (μm)	25.48 \pm 4.34
	Thickness of propria submucosa (μm)	79.42 \pm 16.58
	Thickness of tunica muscularis (μm)	310.46 \pm 26.18
	Length of mucosal fold (μm)	1265.85 \pm 152.36
	Height of epithelium (μm)	28.46 \pm 5.32
	Thickness of propria submucosa (μm)	19.32 \pm 6.52
	Thickness of tunica muscularis (μm)	418.56 \pm 36.15



Graph 1. The average lengths of mucosal folds (μm) in different segments of oviduct in laying Rajasri fowl



Graph 2. The average height of epithelium (μm) in different segments of oviduct in laying Rajasri fowl



Graph 3. The average thickness of tunica muscularis (μm) in different segments of oviduct in laying Rajasri fowl

and was made up of inner thicker circular and outer longitudinal muscle layers. The thickness of tunica muscularis was $310.46 \pm 26.18 \mu\text{m}$ (Table 1).

VAGINA

The tunica mucosa was raised into numerous longitudinal mucosal folds and these are narrow when compared to other parts of oviduct (Fig. 12). The mucosal folds were branched into primary, secondary, tertiary folds and are elongated and thin (Fig. 12). Similarly, Vijaykumar *et al.* (2016) reported in laying Emu birds, Wani *et al.* (2017) in Kashmir faverolla chicken and Nabil *et al.* (2022) in laying Turkey hens as noticed in the present study. The

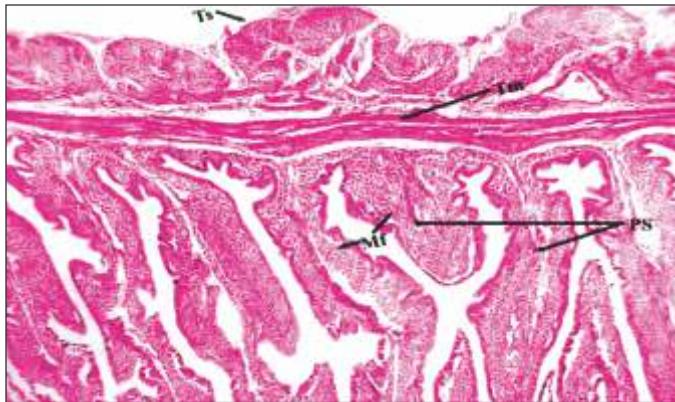


Fig. 1. Photomicrograph of the uterus in laying Rajasri fowl showing different tunics. H&E X40 (Mf- Mucosal fold; PS- Propria submucosa; Tm-Tunica muscularis; Ts-Tunica serosa)

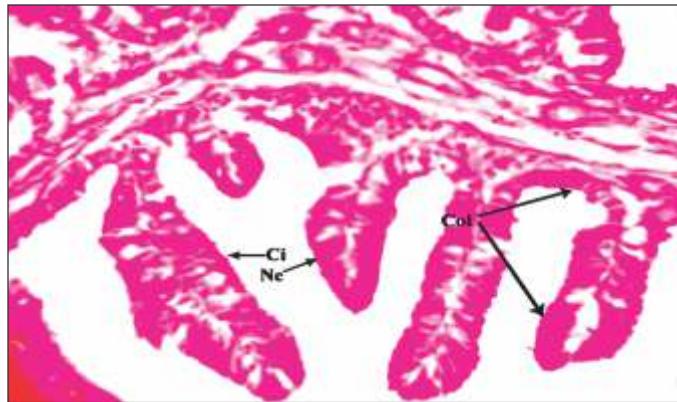


Fig. 2. Photomicrograph of infundibulum in laying Rajasri fowl showing mucosa lined by simple columnar epithelium. H&EX400 (Col- Simple columnar epithelium; Ci-Ciliated cells; Nc- Non ciliated cells)

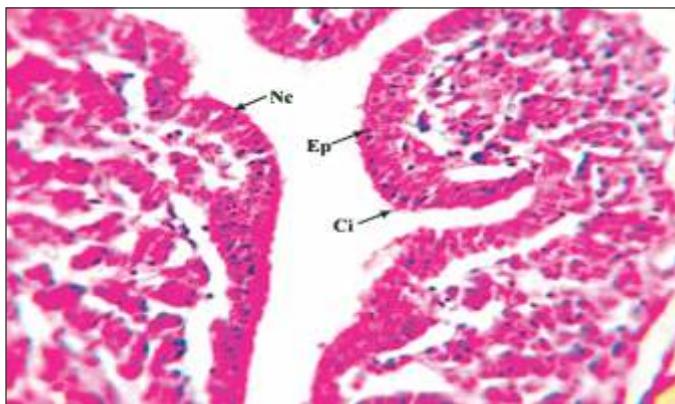


Fig. 3. Photomicrograph of vagina in laying Rajasri fowl showing mucosa lined by pseudostratified columnar epithelium. H&E X400 (Ep- Pseudostratified columnar epithelium; Ci- Ciliated cells; Nc- Non ciliated cells)

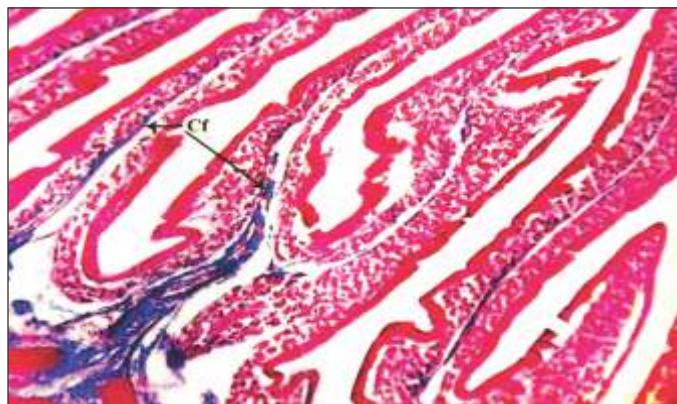


Fig. 4. Photomicrograph of uterus in laying Rajasri fowl showing collagen fibres in core of mucosal folds. Masson's Trichrome X100 (Cf- Collagen fibres)



Fig. 5. Photomicrograph of magnum in laying Rajasri fowl showing reticular fibres in core of mucosal folds. Wilder's X100 (Rf- Reticular fibres)

average length of mucosal fold in the vagina was $1265.85 \pm 152.36 \mu\text{m}$.

The luminal epithelium was lined by pseudostratified columnar epithelium containing both non-secretory prismatic cells and secretory goblet cells (Fig. 3). The lining epithelium was tallest in the vagina among the entire portion of the oviduct. These results were in accordance



Fig. 6. Photomicrograph of uterus in laying Rajasri fowl showing elastic fibres in core of mucosal folds. Verhoeff'sX100 (Ef- Elastic fibres)

with the findings of Islam *et al.* (2021) in adult turkey hens and Nabil *et al.* (2022) in laying Turkey hens. The average height of epithelium was $28.46 \pm 5.32 \mu\text{m}$ (Table 1). The mucosa lacked tubular glands in the vagina.

The lamina propria submucosa was very scanty and continued with muscularis layer. The thickness of lamina propria sub mucosa was $19.32 \pm 6.52 \mu\text{m}$ (Table 1). The

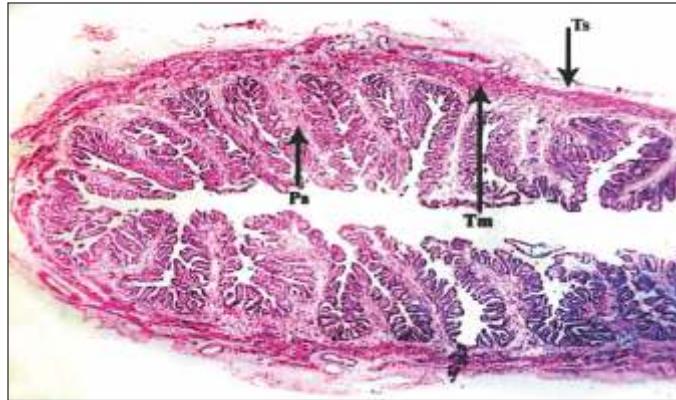


Fig. 7. Photomicrograph of infundibulum in laying Rajasri fowl showing different tunics. H&E X40 (PS- Propria submucosa; Tm- Tunica muscularis; Ts- Tunica serosa)

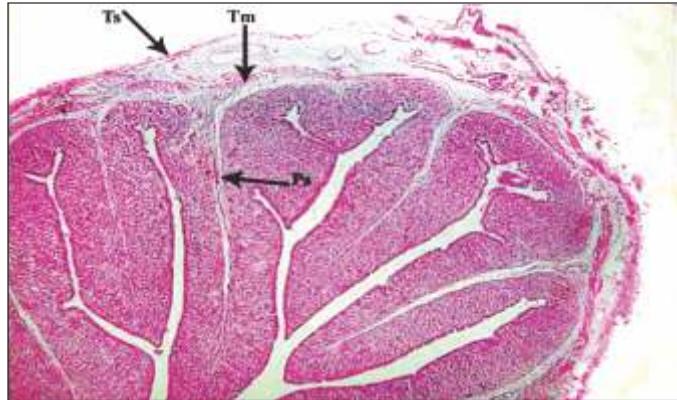


Fig. 8. Photomicrograph of magnum in laying Rajasri fowl showing different tunics. H&E X40 (PS- Propria submucosa; Tm- Tunica muscularis; Ts- Tunica serosa)

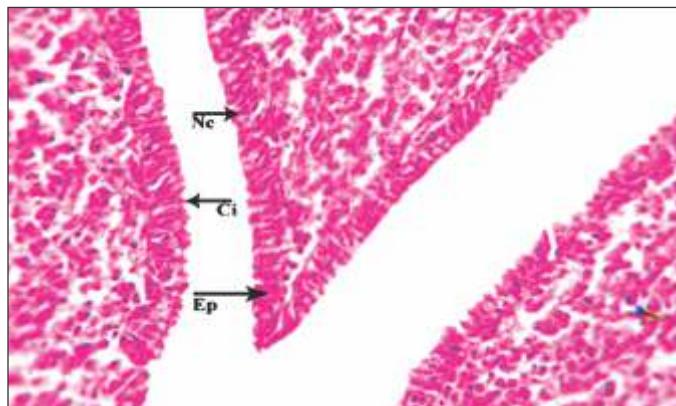


Fig. 9. Photomicrograph of magnum in laying Rajasri fowl showing mucosa lined by Pseudostratified columnar epithelium. H&E X400 (Ep- Pseudostratified columnar epithelium; Ci- Ciliated cells; Nc- Non ciliated cells)

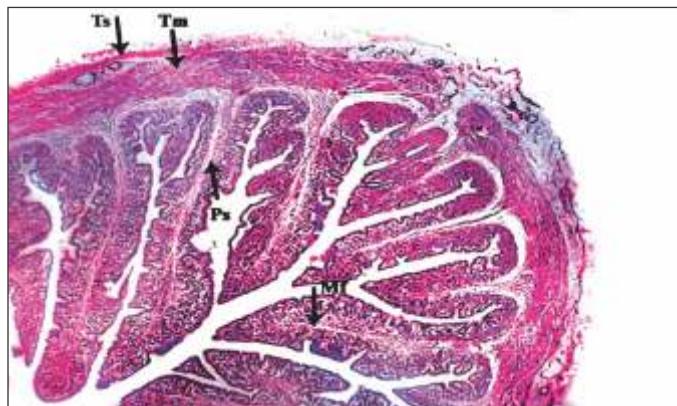


Fig. 10. Photomicrograph of isthmus in laying Rajasri fowl showing different tunics. H&E X40 (Mf- Mucosal fold; PS- Propria submucosa; Tm- Tunica muscularis; Ts- Tunica serosa)

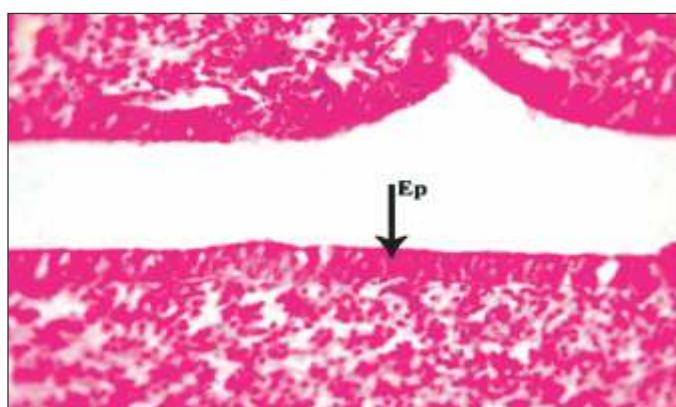


Fig. 11. Photomicrograph of isthmus in laying Rajasri fowl showing mucosa lined by Pseudostratified columnar epithelium. H&E X400 (Ep- Pseudostratified columnar epithelium)

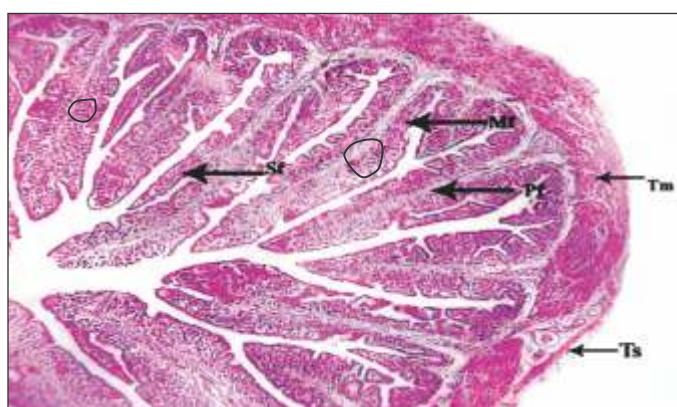


Fig. 12. Photomicrograph of vagina in laying Rajasri fowl showing different mucosal folds. H&E X40 (Mf- Mucosal fold; Pf- Primary fold; Sf- Secondary fold; Tm- Tunica muscularis; Ts- tunica serosa)

tunica muscularis formed the greater part of the thickness in the vagina and was composed of an inner thicker circular layer and an outer longitudinal layer of smooth muscles (Fig. 12). The inner circular layer was strongly developed and formed the vaginal sphincter at the opening of cloaca. Similar findings were noticed by Islam *et al.* (2021) in uterus of adult turkey hens, Gana *et al.* (2022) in adult normal feathered and naked-neck genotypes of Nigerian

chickens and Nabil *et al.* (2022) in laying Turkey hens. The thickness of tunica muscularis was $418.56 \pm 36.15 \mu\text{m}$ (Table 1). The serosa was thin and lined by simple squamous epithelium and contained connective tissue fibres like collagen, reticular and small blood vessels.

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