J. Sylhet Agril. Univ. 3(2):173-180, 2016 **ISSN: 2308-1597**

COMPARATIVE HISTOMORPHOLOGY OF THE OVIDUCT OF THREE LINES OF CHICKEN NAMELY: SONALI, DESHI AND HYLINE CHICKEN

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Abstract

The research work was carried out to elucidate the comparative histomorphology of the oviduct of three lines of chicken like, sonali, deshi and hyline chicken aged between 8 to 10 months. After dissection, histological sections were prepared from different segments of oviduct using Hematoxyline and Eosin (H&E). Oviductal histology varied in regards to the mucosal folding, lining epithelium, and distribution of glands and connective tissues arrangement. Among the sonali, deshi and hyline chickens mucosal folds were taller in hyline chicken in the first three oviductal segments, but the mucosal folds of the last two segments were taller in deshi chicken, where in sonali chicken the mucosal folds were comparatively shorter. The mean height of mucosal folds of oviductal segments, infundibulum (1495.8±320.32 µm, 1916.7±341.57 µm and 2291.7±430.60 µm), magnum (283.33±51.64 µm, 566.7±132.92 µm and 775.00±223.05 µm), isthmus (1387.5±602.86 µm, 1566.7±182.80 µm and 1862.5±361.16 µm), uterus (1458.3±66.46 µm, 1716.7±143.76 µm and 1416.7±408.25 µm) and vagina (1145.8±94.10 µm, 1645.8±94.10 µm and 1541.7±204.12 µm) in sonali, deshi and hyline chicken, respectively. In all three types of studied birds, the lining epithelium of infundibulum was ciliated columnar epithelium, and in the other segments the epithelium was pseudostratified ciliated columnar. The populations of submucosal glands were higher in the magnum than other segments and comparatively more in amount in hyline chicken. The distributions of sperm host glands were noted in the lamina propria of the vagina. Different lines of chicken showed differences in the oviductal histoarchitecture and can be important indicators in reproduction.

***Keywords*:** Histomorphology, oviduct, chicken, mucosal folds, glands.

Introduction

The avian oviduct is an amazing organ, producing all the structural components of the laid egg except the yolk, including the egg-white and eggshell. The oviduct in the mature hen in egg production consists of morphologically and functionally distinct segments with a total length of 80 – 85 cm (Bakst *et al.*, 1994). Soon after ovulation, the fimbriated region of the infundibulum ensures the ovulated yolk gather into the ostium, consequently passes through different segments of oviduct where the albumen, shell membrane and the hard shell is deposited in the magnum, isthmus and uterus, respectively. The most caudal vagina, a conduit between the uterus and cloaca add cuticle to the egg just before oviposition. The time elapsed from ovulation to oviposition is about 24 hrs and this process is mediated by a series of hormones (Warren, 1949).

In presence of the sperm, the ovum may be fertilized. Avian spermatozoa survive in the female reproductive tract and can be stored in the oviductal sperm storage area located in the uterovaginal junction (UVJ) and are capable of fertilizing eggs for days or weeks in many species (Lake, 1971). To fertilize the ova on a regular basis sperm are released continuously from the UVJ, from where the sperm travel to the site of fertilization at the cranial end of the oviduct (Bakst *et al.*, 1994). In research on avian fertility it is often necessary to consider sperm-oviduct interactions such as oviductal storage of spermatozoa.

Fertility and hatchability of eggs are the most important determinant in poultry rearing and depend on a number of factors like genetic, physiological and environmental (Warren, 1949; Olsen, 1942). In Bangladesh the available

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chicken types are indigenous non-descript local chicken called deshi chicken, the cross breed chicken and hybrid chicken. Farooq *et al.* (2002) found higher fertility in Deshi (74.47±0.08%) than in Fayumi (64.71±0.23%) and RIR chicken (53.06±0.45%). They observed 80.79% egg fertility and 71.73% hatchability of fertile eggs in deshi chicken though the annual egg production is very poor.

Histologically it is revealed that the wall of the oviduct comprise four layers where the lining mucosa varies depending on the stage of production (Bakst, 1997). Histological and ultrastructural studies of avian oviduct were exclusively conducted on hybrid chicken (Bakst, 1997; Khan *et al.*, 1999). Some research work has been conducted on the histoarchitecture of oviduct of native chicken of Bangladesh (Mishra *et al.,* 2014), comparative histomorphology of uterus of laying chicken and duck (Mohammadpour, 2007), postnatal growth and development of the oviduct of deshi chicken (Islam *et al.,* 2002), however, histological comparison of different segments of oviduct among deshi, crossbred and hybrid chicken is yet to venture. Therefore, the present work has been carried to study comparative histomorphology of the oviduct of three lines of chicken namely, Deshi, Sonali and Hyline chicken.

Materials and Methods

The present study was conducted in the laboratory of the Department of Anatomy and Histology of Sylhet Agricultural University, Sylhet.

Experimental birds

Adult female chicken of three lines (Deshi, n=6; Sonali, n=6; and Hyline, n=6) were used. These chickens were purchased from the village farmers and nearby farm close to Sylhet Agricultural University, Sylhet. The age of the birds ranged from 8 to 10 months which was based on the farmers' information. The birds were reared for 2 weeks in a nearby shed supplying layer feed and adlibitum water before they were sacrificed.

Collection of sample

In this study, chickens were sacrificed by cervical subluxation. Standard anatomical dissection of each bird was done as described by Fujii (1963). The whole oviduct was quickly dissected out and stretched on tray. The oviducts which were free from gross pathological disorder were used in the experiment.

Preparation of tissues for histomorphological study

After collecting the oviducts, segments of the oviducts were separated. From each segment, small pieces were fixed in Bouins fluid (Gridly, 1960) for 24 hours. After fixation, the samples were dehydrated in the series of ascending grade of alcohol (70%, 80%, 90%, 95%, 100% I, 100% II and 100% III) for 2-3 hours each. Followed by clearing in three changes of xylene, each for 30 minutes interval, the tissues were infiltrated with paraffin. As soon as the infiltration was completed, the tissues were embedded in paraffin and finally the embedded paraffin blocks were attached with block holder. Tissues were sectioned at 6 micrometer (µm) thickness using sliding microtome (MIC 509, Euromex, Japan). After sectioning, the sections were floated on lukewarm water floatation bath for stretching and then the paraffin sections were mounted on slides glass using an adhesive (egg albumins) and dried 6 to 24 hours on hot plate of slide warmer boxes.

In order to study the histological structures of oviduct, tissue sections were stained with Mayers Hematoxylin and Eosin method (Gridley, 1960). Finally, slides were mounted with DPX which was kept over the tissue section and dried for 24 hours. After all these preparation of slides, photographs were taken with microscope equipped with a camera (Nikkon, Japan).

Under the microscope, the histological layers of the segments of the oviduct such as tunica mucosa, sub mucosa and muscularis were examined. The size and shape of the epithelium and the height of the mucosal folds of the different segments of the oviduct were also examined.

Statistical analysis

In the present study, the heights of the mucosal folds of different segments of the oviduct measured and analyzed. Statistical analysis of the recorded data was carried out using ANOVA.

Results and Discussion

General morphology of the oviduct

The oviduct consisted of five distinct segments extending from ovary to cloaca, like infundibulum, magnum, isthmus, uterus and vagina. In the junction between the uterus and vagina, sperm host gland resides as reservoir of sperm. Khan *et al.* (1999) reported the presence of sperm host gland in native chicken of Bangladesh while studying the lymphocytes of sperm host gland. In the vicinity of the oviductal sperm host glands of deshi chicken, Das (2003) reported the presence of neural tissues and smooth muscle elements. While studying the gradual development of oviduct of deshi and hybrid (white leghorn) chicken from day old chick to adult, Kar (1947) reported the changes from thin fiber to coiled structure. The work of Mishra *et al*. (2014) reported similar findings in the oviduct of deshi chicken. In the present study using the adult chicken of three lines, oviduct was found as highly convoluted structure, occupied the major part of the abdomen. In case of deshi and hyline chicken, the tube was comparatively better formed than sonali chicken regarding the thickness of the wall and coiling (Fig. 1

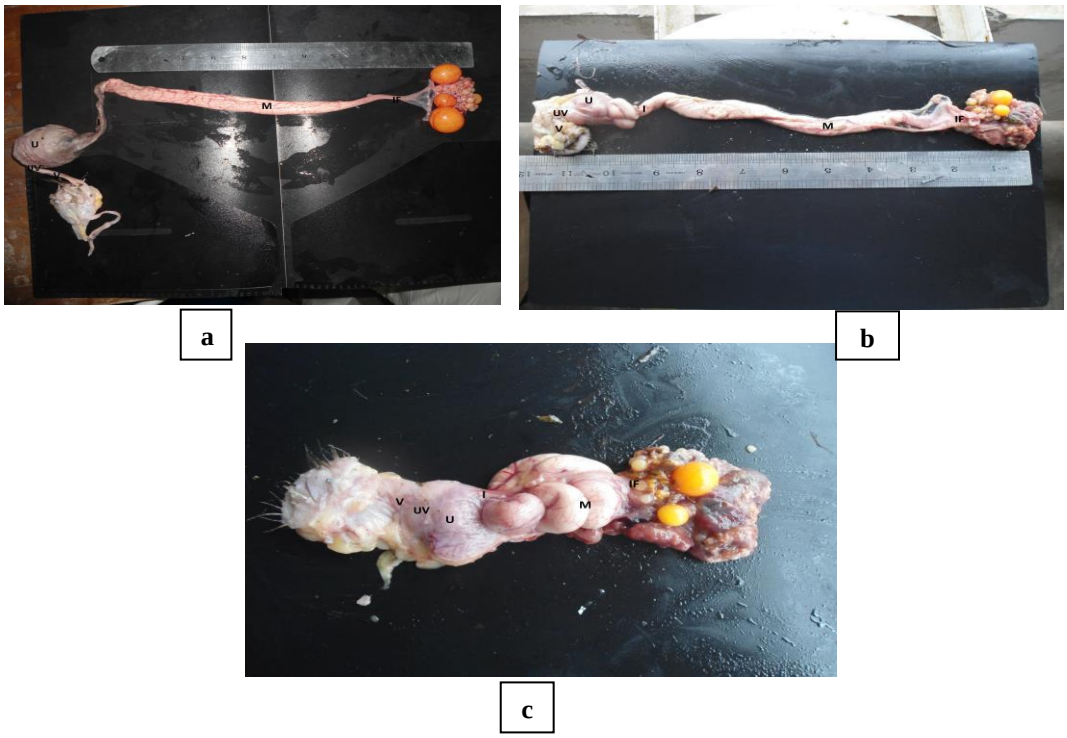

Fig. 1. Photographs of the oviduct after dissection; a) Sonali chicken, b) Deshi chicken, c) Hyline chicken. IF= Infundibulum; M= Magnum; I= Isthmus; U= Uterus; V= Vagina; UV= U-V junction

Histology of the oviduct

The histological features of the oviduct resembled in all three types of studied birds. Presence of mucosal folds throughout the entire oviduct was common feature in all the three groups which were of various patterns and small to large in height depends on the segments of the oviduct. The mucosal folds were numerous and prominent in the infundibulum and least extensive in the magnum. In the initial segment, the lining epithelium was found simple ciliated columnar which were later noted as pseudostratified ciliated columnar epithelium. Presence of lamina propria-tunica submucosa containing tubular glands, diffused fibroblasts, collagen fibers and absence of muscularis mucosa was conspicuous in the entire oviduct. In the junctions of the uterus and vagina, the glands were called sperm host glands or sperm storage tubules. Following submucosa, the tunica muscularis was seen composed of inner circular and outer longitudinal surrounded by serosa. The muscular layer in day old chick remained as very

thin structure which developed moderately at 12 weeks and at 30 weeks attained full structure (Curtis, 1910; Mishra *et al.*, 2014). Avian oviduct was also studied by many other authors in different strains and breeds (Khan *et al.*, 1999; Islam *et al.*, 2002; Parto *et al.*, 2011) and reported as consisting of lamina epithelia, gland, connective tissues, muscle layer and outer serosa, however, the structure of these components varied according to the segment of oviduct as well as the type of birds studied.

Table 1. Height of the mucosal folds (mean±SD) of the different segments of oviduct (µm) of three lines of Chicken (Deshi, Sonali and Hyline) (n=6)

Segments of oviduct of chicken	Height (µm) of the mucosal folds (mean±SD)		
	Deshi	Sonali	Hyline
Infundibulum	1916.7±341.57	1495.8±320.32	2291.7±430.60
Magnum	566.7±132.92	283.33±51.64	775.00±223.05
Isthmus	1566.7±182.80	1387.5±602.86	1862.5±361.16
Uterus	1716.7±143.76	1458.3±66.46	1416.7±408.25
Vagina	1645.8±94.10	1145.8±94.10	1541.7±204.12

Infundibulum: In the initial oviductal segment the mucosal folds were seen as long and spiral with very little glands, however a great variation existed among the sonali, deshi and hyline chickens. In sonali chicken, the folds were shorter and less developed in comparison to deshi and hyline chicken where the folds were taller in deshi chicken and coiled in hyline birds. The height of the mucosal folds of the infundibulum in the sonali, deshi and hyline chickens were 1495.8±320.32 µm, 1916.7±341.57 µm and 2291.7±430.60 µm, respectively (Table-1). Bansal *et al.* (2010) found that the mucosa was highly folded and branched in the cranial part of the infundibulum in Punjab white quails and the length of the mucosal folds was 2625±14.97 µm in the said part of oviduct. Variation in the species and breed might be the reason of the different lengths of mucosal folds. The lining epithelium was tall ciliated columnar epithelium in all three types of chicken. This result was similar to the findings in deshi chicken (Mishra *et al.*, 2014) and also in other fowl (Richardson, 1935). The lamina propria was rich in collagen fibers and lymphatic nodules. The lymphocytic aggregation was more numerous in sonali and deshi chicken than in hyline chicken (Fig. 2 a, b)

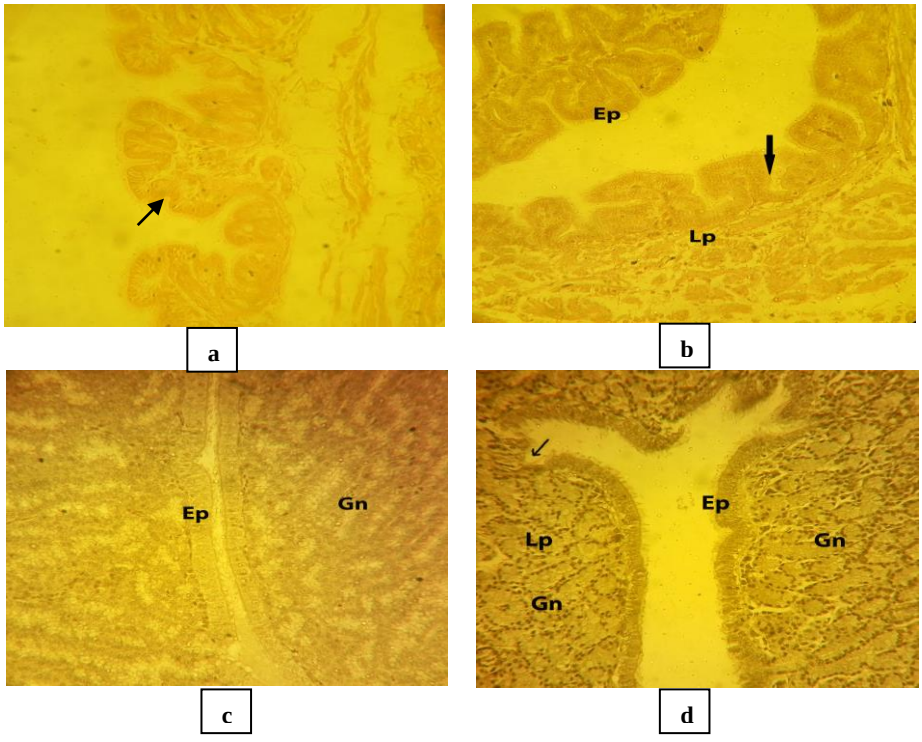

Fig. 2. Mucosal folds (arrow) in the (a) infundibulum of deshi chicken, (b) infundibulum of hyline chicken, (c) magnum of deshi chicken, (d) magnum of hyline chicken. Ep; Luminal epithelium, Lp; Lamina propria and Gn; Glands. (H&E staining ×40)

Magnum: This is the albumen secreting region, where the mucosal folds were comparatively shorter than other regions of the oviduct (Table 1) and were associated with profuse number of underling glands open to the epithelial surface (Figs. 2 c, d and 3 a). The average height of the mucosal folds of magnum in the sonali, deshi and hyline chicken were 283.33±51.64 µm, 566.7±132.92 µm and 775.00±223.05 µm, respectively. Heights of the mucosal folds were studied in Punjab white quails in this oviductul segment and were almost same as sonali chicken (Bansal *et al.*, 2010). The lining epithelium was pseudostratified ciliated columnar epithelium with goblet cells, though Mishra *et al.* (2014) reported ciliated columnar there. The tubular mucosal glands were found copious in hyline chicken than deshi and sonali chicken. Islam *et al.* (2002) observed the glands in the magnum at 30 weeks of deshi chicken where Khan *et al.* (1999) observed well distributed glands in White Leghorn chicken at only 19 week age of chicken. Therefore, it can be considered that hyline hens have higher secretory function of albumen than deshi and sonali hens.

Isthmus: The average height of the mucosal folds of the isthmus in the sonali, deshi and hyline chicken were 1387.5±602.86 µm, 1566.7±182.80 µm and 1862.5+-361.16 µm, respectively (Table 3, Fig. 1). The mucosal folds of the both deshi and hyline chickens were taller and highly developed than the sonali chicken. The epithelium of the isthmus was lined by pseudostratified ciliated columnar cells in all types of chickens (Fig. 3 c). Same results came from the observation of Fujii (1963), in White Leghorn chicken. Bansal *et al.* (2010) reported that the lining epithelium of isthmus of Punjab white quails varied from simple columnar ciliated to pseudostratified columnar ciliated type. The results differ from the present study due to the species variation. The underlining glands associated with secreting shell membrane were found less pronounced than magnum and among the studied birds these glands were abundant and more prominent in sonali chickens (Fig. 3 b). The glands were reported by several other authors in the isthmus of laying deshi chicken and in other fowls (Islam *et al.*, 2002; Mohammadpour, 2007). However, the findings of Mishra *et al.* (2014) differ with the present findings, where they reported more tubular glands in isthmus than magnum.

Uterus: The height of the mucosal folds in the uterus of deshi chicken was more than the other two types of chicken (Table 1). The present finding goes similarly with several other authors (Bansal *et al.*, 2010; Mohammadpour,

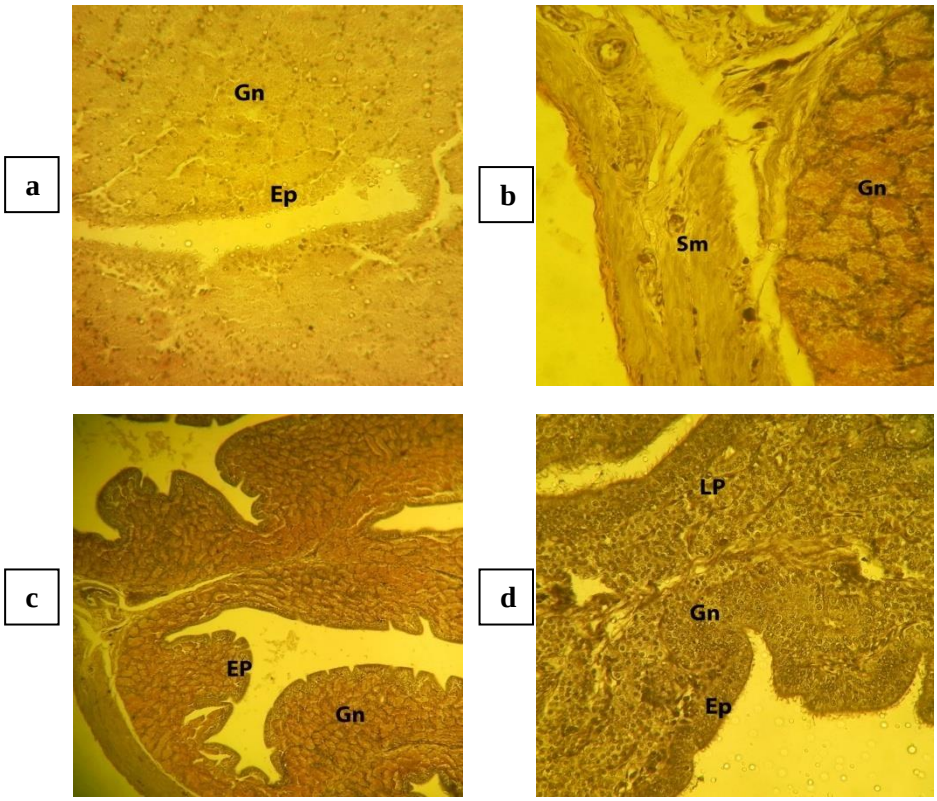

Fig. 3. Photograph showing the histology of (a) magnum in sonali chicken, (b) isthmus in sonali chicken, (c) isthmus hyline chicken, (d) uterus in deshi chicken. Ep; Luminal epithelium, Lp; Lamina propria and Gn; Glands. (H&E staining, ×40)

2007). Yoshimura (1996) reported a positive correlation between the height of uterine mucosal fold and the thickness of the eggshell. The epithelium of the uterus was lined by pseudostratified ciliated columnar cells in all types of chickens (Figs. 3 d and 4 a, b). Bansal *et al.* (2010) also found that the uterine epithelium was pseudostratified columnar type with ciliated and non-ciliated cells in Punjab white quails. The findings are almost similar to the present study. Yoshimura *et al.* (1996) observed that the surface of oviductal mucosa in White Leghorn laying chicken was lined by well-developed epithelium but did not mention the type of epithelium.

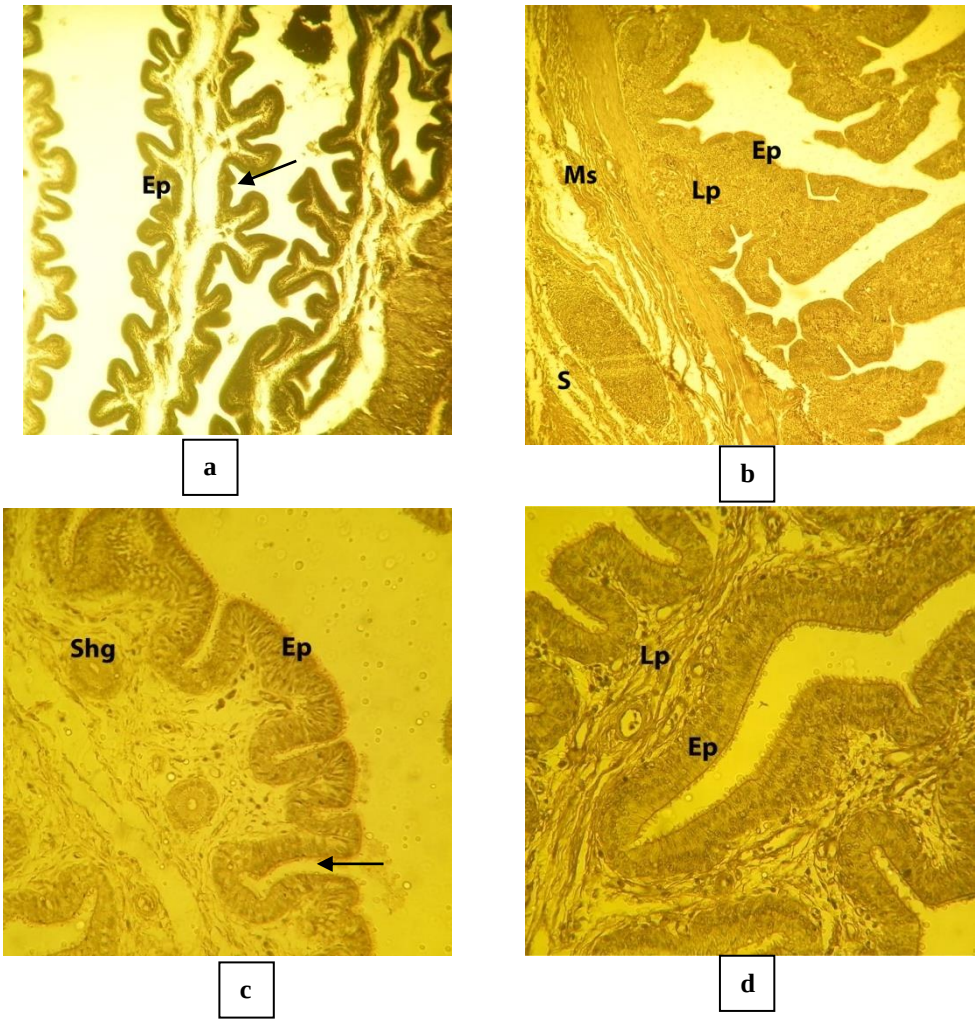

Fig. 4. Photograph showing the histology of (a) uterus in sonali chicken, (b) uterus in hyline chicken, (H&E staining, ×40) (c) vagina in sonali chicken, (d) vagina in hyline chicken. Ep; Luminal epithelium, Lp; Lamina propria, Ms; Muscularis layer, S; Serosa, Shg; Sperm host gland and Gn; Glands. (H&E staining, ×100)

Vagina: In vagina, the mucosal foldings were comparatively longer in deshi and hyline chicken than sonali chicken. The mucosal folds of vagina of Panjab white quails was 1129.77±40.78 µm (Bansal *et al.*, 2010) and have the similarities with the findings in case of sonali chicken. The mucosa was lined by pseudostratified ciliated columnar epithelium (Figs. 4 c, d and 5 a).

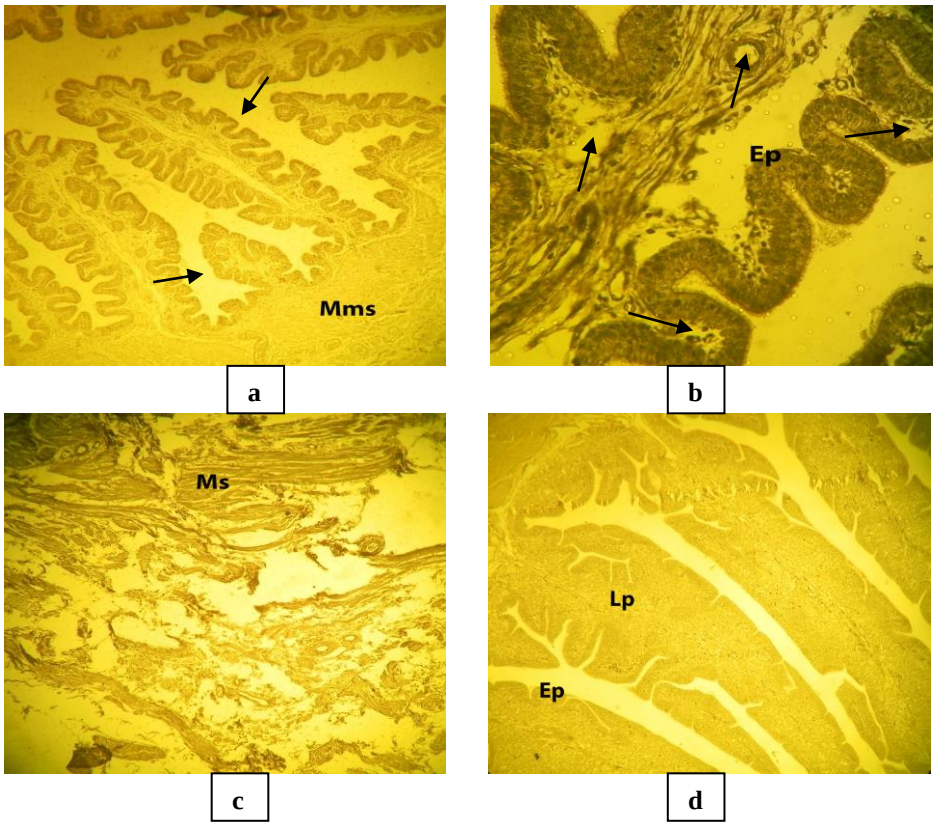

Fig. 5. Photograph showing the histology of (a) vagina in hyline chicken, H&E staining, ×10, (b) utero-vaginal junction and sperm host glands in hyline chicken, H&E staining, ×40, (c) utero- vaginal junction in deshi chicken, H&E staining, ×10, (d) of utero-vaginal junction in deshi chicken, H&E staining, ×40. Ep; Luminal epithelium, Lp; Lamina propria, Mms; Muscularis mucosa layer, Ms; Muscularis layer, S; Serosa, Shg; Sperm host gland and Gn; Glands. (H&E staining, ×40)

In the vagina, the very few glands were present in lamina propria in all types of chicken and the findings were similar with the findings of Fujii (1963), in White Leghorn chicken and Islam *et al.*, (2002) in local deshi chicken. The tunica muscularis of the vagina was highly developed and consisted of smooth muscle bundles and collagen fibers in both deshi and hyline chickens (Fig. 5.c, d). In the present study the sperm host glands were found in the lamina propria of the vagina (Fig. 5 b). Khan *et al.* (1996, 1999) found that at 12 to 30 weeks of White Leghorn chicken, the sperm host gland were present in the lamina propria of the vagina. These results have close similarity with Bobr *et al.* (1964) and Khan *et al.* (1999) in White Leghorn Chicken. In conclusion it can be stated that different lines of chicken showed differences in the oviductal histoarchitecture and can be important indicators in reproduction.

Acknowledgement

The authors would like to acknowledge SAURES for funding (UGC 2013-2014) the research work and also the Department of Anatomy and Histology, Sylhet Agricultural University, Sylhet, 3100, Bangladesh, for providing facilities to conduct the research work.

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