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ANATOMICAL STUDY OF THE GENITAL TRACT OF TURKEY HEN *MELEAGRIS GALLOPAVO*

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ABSTRACT
The study includes (10) females indigenous adult turkey hens (*Meleagris gallopavo*), these birds purchased from local supplier in Diala city, Iraq. The age of these birds about (45-55) weeks and the average weight of 5.5 kg**.** The present study was conducted to determine the anatomical structure of the ovary and oviduct in indigenous turkey hen (*Meleagris gallopavo*). 10 adult's turkey hens. Anatomically, the adult left ovary of indigenous turkey hen during sexual activity resembles a bunch of grapes which contains large, medium, and small follicles with mean weight (74.33±2.49gm). It's related cranially to caudal extremity of the lung, ventrally, to the abdominal air sac and dorsally to the kidney and adrenal gland. The oviduct of adult turkey hen appeared as a highly convoluted and muscular tube with mean weight (59.66±1.52gm) and mean length (87.57±37cm), which transport the ovum from the ovary, the place of fertilization, deposition of albumen, formation of membranes, and finally to form the full-grown egg. It is divided into five regions namely: Infundibulum, Magnum, Isthmus, Uterus or Shell glands and vagina extended from the single ovary to cloaca and occupying a large part of the abdominal cavity.

KEYWORDS: *Meleagris gallopavo,* Genital track, Turkey hen, sexual activity etc.

INTRODUCTION

Generally, In birds including all the domestic birds, the female embryo has a pair of undifferentiated gonads and the mullerian ducts, however, during the course of differentiation of the female avian embryo, only the left ovary and the mullerian duct develop, whereas, the right ovary and mullerian duct regress. The left mullerian duct continues to grow and develop into the oviduct[1, 2]. The left ovary occupies the dorsal part of the mid-region of the coelom. It lies in extensive contact with the cranial division of the left kidney, and also overlaps the cranial division of the right kidney. It's closely related cranially to the caudal end of the left lung. Ventrally it's covered by the left abdominal air sac; dorsally, it is in contact with aorta and caudal vena cava and covers the left and right adrenal glands. The base of the left ovary is attached to the dorsal wall of the celom by a fold of peritoneum, the mesovarium, which basically suspended the ovary in the celom[3] In the genetic female the left ovary very soon becomes larger than the right. Even before the end of indifferent phase of embryonic development. From the middle of incubation until hatching the left ovary is shaped like an isosceles triangle, the apex pointed caudally; It's color is pale yellowish pink with surface granular (Blount,1945). It's size increase very slowly from hatching until the age of about 120 day, the weight being at about 0.5gm or within approximate range of 0.3 to 0.45gm and1.5cm long[5,6]. All the follicles are microscopic throughout this period. one or more follicles over 1mm in diameter appear after 120 day, but the main growth of the ovary occurs from 150 to 180 day; during this phase many oocytes reach their full size, and the ovary increase in weight to 50 to 60gm[5]. Amin [6] referred that the adult left ovary of the mature domestic hen during sexual activity resembles a bunch of grapes, this is because numerous rounded follicles of varying size project from the ventral surface of the ovary, each being suspended by a pedicle or follicular stalk. In an actively laying bird about 4-5 very large follicles are present, with diameter of up to about 40mm. up to about 2500 oocytes are visible to the naked eye. Thousands of small oocytes remain deeply embedded within the ovary, however, and are visible with a dissecting microscope. In the hen, after a phase of sexual activity has ended, the ovary becomes reduced to the size and shape of the resting phase. During the resting phase the adult left ovary is an elongated flattened oval, with a rounded and transversely widened cranial extremity and more pointed caudal extremity, It is about 3cm in craniocaudal length, 2cm transversely and 3.5 to10 mm dorsoventrally. At this stage it is weight only 2 to 6gm. The oocytes are small or minute, and grayish white in color [7, 8]. (the female birds in some species of birds such as "the Browm Kiwi" have two functional ovaries and the left oviduct is reported to be specially positioned to receive oocytes from both right and left ovaries[9,10]. the adult female of Cooper's Hawk (Accipiter cooperi) had bilateral ovaries, only the left oviduct was active. The left ovary was somewhat larger than the right ovary, and the left ovary contained more large follicles than that the right ovary. However, the smallest follicles in the right ovary appeared to be larger than the smallest follicles in the left ovary. The avian oviduct has been studied extensively in some poultry birds, especially the domestic fowl [12, 13] In the sexually active birds, the oviduct is a tortuous tube extending from single ovary to the cloaca and occupying a larger part of the abdominal cavity [14]. The oviduct can be divided into five anatomically and functionally regions, these five regions include Infundibulum, which forms a strong perivitellin membrane around the egg yolk.

Magnum, which is responsible for synthesis and secretion of albumin. Isthmus, which forms a fibrous membrane around the egg white. Uterus, which forms the egg shell Vagina, which connects the uterus to the cloaca [15,16]. The much convoluted oviduct of the laying domestic fowl completely occupies the left dorsal quadrant of the coelom, and also to some extent the left ventral quadrant. So tightly packed are the coils. Sometimes the coils also cross the dorsal midline, displacing the intestine ventrally and to the right[17]. Caudal to the level of the ovary the topographical relations of the coils are as follows: dorsally, to the ventral surface of the left kidney and often to the right kidney, and to the dorsal body walls; laterally, to the left lateral body wall; ventrolaterally on the right side, to the intestine in general and ceca in particular; ventrally on the left, to the dorsal surface of the gizzard and spleen. The left abdominal air sac, however, separates the oviduct from the left body wall and gizzard. The medial (right) wall of this air sac fuses with dorsal ligament of the oviduct and, caudally with the oviduct itself [18]. The oviduct of the domestic fowl is suspended from the roof of the celom by a double –layered sheet of peritoneum. This sheet is divided by the oviduct into the dorsal and ventral ligament [19, 20]. The cranial part of its dorsal attachment runs diagonally from the left fourth thoracic rib to the cranial division of the left kidney. Passing close to the left lateral aspect of the ovary, it places the slit- like opening of the infundibulum in a good position to catch an ovum within the ovarian pocket. The remainder of dorsal attachment runs parallel with the midline along the left kidney as far as the cloaca. The ventral attachment is along the whole length of the oviduct. The dorsal ligament is therefore essentially fan-shaped, the handle of the fan being dorsal. The ventral ligament of the oviduct arises from the caudal tip of the funnel to the first segment of the vagina. Even in the immature bird at 10 weeks it does not extend to the caudal half of the vagina. The ventral border of the ligament is it's free edge. In mature bird this border is reinforced by smooth muscle, which becomes progressively thicker caudally and culminates in a solid muscular cord about 5mm in diameter. This cord fuses with the ventral surface of the pouch- like main portion of the uterus and with the first segment of the vagina. The ventral ligament is again fan- shaped, the handle of the fan being the relatively short ventral border [3].

Infundibulum: In laying hen, the infundibulum composed of a funnel followed by a tubular region. The total length of the two regions ranges from 4 to 10cm with a mean total length 7cm [8,20]. The funnel opens immediately caudal to the ovary, offering an exit from the caudodorsal part of the ovarian pocket. It has no direct attachment to the ovary. The extreme thinness of the wall of the funnel, particularly at its fimbriae edge, enables it to penetrate between the large follicles which are suspended from the ovary. Its color is a delicate pink. The mucosa has low, somewhat oblique, longitudinal folds, which gradually and progressively increase in height [21]. The funnel tapers rapidly to form tubular (neck) region of the infundibulum. The wall of this part of the infundibulum is thicker than that of the funnel, but thinner than any other part of the oviduct. Internally the folds, which form a gentle spiral, continue to become gradually taller, but are much more delicate than those of magnum. The transition into the magnum is quite abrupt being market by the sudden massive enlargement of the folds [17]. In domestic fowl, the first segment of oviduct is the infundibulum. It has been subdivided into three functional and morphologically distinct regions: the fimbriated region guides the ovulated ovum into the ostium of the Infundibulum; the funnel region, the site where sperm first contact the recently ovulated ovum; and the chalaziferous region, which will be referred here as the distal infundibulum [22,23,24]. In the female emu (*Dromaiusno vaehollandiae*), the infundibulum consists of two segments: a funnel- shaped portion with its opening and fimbria followed by a tubular portion (tubules in fundibula is), also known as the chalaziferous zone. The average length of the infundibulum is 6.17 ± 0.29cm. The funnel portion of the infundibulum opens by an elongated slit known as the ostium infundibulate, and surrounded by thin, flared lips with small finger- like projections known as the fimbriain fundibulate. The mucosal folds of infundibulum have an approximate height 1.5mm and are seen only in the tubular region of Infundibulum. These folds are oriented longitudinally and become more pronounced near the caudal portion of this segment [25]. In mature rhea (*Rhea Americana*), the infundibulum has funnel shape, its wall is thin, elastic, light-rose colored and almost trans lucid, mainly in its cranial portion, the ostium infundibulum is the entrance of infundibulum and luminal side show distinct longitudinal folds which represent the fimbriae of primary and secondary order [26]. In ostrich (*struthio camelus*), the infundibulum is formed of cranial funnel-shaped and caudal parts. The funnel shaped part is opened toward the left ovary by a wide, slit- like opening, its wall is thin and gradually increases in thickness on reaching the tubular part and is folded forming secondary and tertiary folds [27, 28]. In brown kiwi, the infundibulum extends the whole width of the celiac cavity and is therefore able to receive oocytes from the left and right ovaries, both of which are functional in the species [10, 29] mentioned that the infundibulum of the laying hen is divided into a funnel like region, the fimbria also referred to as the ampulla, and the more elongated, tubular neck region also referred as the chalaziferous region. The neck gradually merges with the proximal segment of the magnum. The surface mucosa of infundibulum is thrown into a series of primary and smaller secondary folds clearly more voluminous and longitudinally orientated at the neck region. In the laying hen is the largest and most coiled portion of the oviduct about 34cm long. Its wall is much thicker than that of the infundibulum [10]. The magnumin white leghorns hen the folds of the magnum are higher and thicker than the folds in all the other parts of the oviduct [30]. There are 22 primary folds, each making an angle of about 10 to 15 degree to long axis of tube, each primary fold is about 4.5mm high and 2.5mm thick. The color of the mucosa during secretion is either milky white or luminous gray [17]. In the female emu (*Dromaius novaehollandiae*), the magnum measures 4.83 ± 1.27cm in length of the length of the oviduct. The mucosal folds of the magnum are more distinct on gross observation and also have a spiraling pattern to their longitudinal orientation. The mucosal folds of this region have an approximate height of 2.4mm [25]. In

mature rhea (*Rhea Americana*), the magnum is dilates caudally from the infundibulum. The thick and resistant wall, when distended has longitudinal luminal folds. The cranial portion has 5-6 mm, thick, and voluminous yellowish fold. The caudal portion has whitish and low 2-3 mm folds [26].

Isthmus: In the laying hen, the isthmus is short and slightly reduced in diameter which extends from the a non glandular zone, which delimits it from the magnum, to the tubular shell gland, which to absolute eye is marked by a distinct color change from off- white to brown .The average length from about 4 to 12cm, with a mean length and diameter of about 8cm and 1cm respectively. The boundary between the isthmus and magnum is sharply distinguished by a narrow band of tissue about 1 to 3cm wide (the zona translucence) [3,10]. The primary folds in this boundary zone are reduced to about 1.5mm in height. Subsequently, they gradually increase in height but are always narrower and shorter than those of the magnum. The number of primary folds of the isthmus is about 18 to 20. The color of the mucosa has been described as yellowish brown, darker than the rest of the oviduct or white [8]. In the female Emu (*Dromaius novaehollandiae*), Its average length 5.83 ± 0.94.This region appears similar in size to the magnum; however, it is significantly more narrow than uterus. The mucosal folds are oriented more obliquely and have an approximate height of 1.8mm. A zonal translucence was not identifiable in this region [25]. In mature rhea (*Rhea Americana*), the isthmus is about 5.6cm length, its wall is thinner and the luminal folds less voluminous than that in the magnum, these folds are prominent, but become finer in caudal portion [26]. In ostrich (*struthio camelus*), the isthmus appear as a short tube, successive to the magnum, its wall thicker than that of the magnum, also it has a well-developed muscular coat than that of the magnum. The luminal folds of isthmus are arranged in a branched convoluted folds separated by deep furrows (Saber *et al*., 2009). Wolford et *al*., (1964).reported that the mean length of isthmus in Japanese quail, is about 6.3cm and the ovum remains in the isthmus approximately 1.5-2 hours. Uterus in domestic fowlthere is no distinct anatomical boundary between the isthmus and uterus. It's a relatively short region about 8cm long in the domestic fowl. The cranial part is short and relatively narrow, also called (red region) through which the egg passes rapidly. The major part is pouch like which holds the egg during shell formation [10]. In the laying hen, the uterus is a short sac-like expanded region. Its length ranges from about 4 to 12cm with a mean length and diameter about 8cm and 3cm respectively. The musculature of the uterus well developed particularly the outer longitudinal layer[8,26] In the female Emu (*Dromiousnovaehollandiae*), The uterus is a long, expanded area of the emu reproductive tract. Its average length is 9.53 ± 0.55cm of the oviduct length. The mucosal folds have a slight spiral pattern with an oblique orientation in the cranial two-thirds of the uterus but gradually changes to a longitudinal orientation in the caudal two-third of the uterus[25]. In ostrich (*struthiocamelus*) the uterus appears as sac-like dilatation present between the isthmus cranially and the vagina caudally, the wall of the uterus is thicker than that of the isthmus and the mucosa of the uterus is arranged in longitudinal folds, which are separated by narrow clefts [28]. In mature rhea (*Rhea Americana*), The uterus is a bag-shaped uterus with a length about 16.0cm. in the cranial area show thin folds, and are more ramified folds in its caudal region [26]. In duck, weight of the uterus was low and its length was shorter than that in hen. In hen the total weight and length of the uterus was about 14.98 ± 2.54gm and 7.70cm respectively, while in duck the total weight and length of the uterus was about 9.27 ± 2.04gm and 7.27cm respectively[32]. Vagina:In domestic fowl, the vagina is the terminal portion of the oviduct. The Junction of the uterus with vagina is marked by vaginal sphincter which belongs to the beginning of the vagina. The powerful muscle of the vagina wall is thicker than that of any other part of the oviduct [10]. In chickens and turkey, the vagina have been described as an S-shaped segment, serving as the conduit between the uterus and cloaca at the time of oviposition [33,34]. In laying hen, the mucosa of vagina is white with delicate mucosal folds and are arrange longitudinal rather than spiral and are much thinner and lower than that in any other part of the oviduct except the funnel of the infundibulum [24]. In the female Emu (*Dromious novaehollandiae*). The vagina has averages 7.0 ± 20cm long of the oviduct length. The mucosal folds have an approximate height of 3.3mm and are oriented longitudinally in an extremity tortuous pattern. The vagina is continuous with the cloaca via the cloacalostium [25,26,35] observed that the vagina of the mature Rhea (*Rhea Americana*) has an interior long primary and secondary folds being oriented subsequently transversally. Its average is 11.5cm in length formed by a short muscular tube which starts inside the uterus and ends in the cloaca. In ostrich (*struthiocamelus*) the vagina is tube-like structure connecting to the uterus cranially and opened on the urodeum of the cloaca caudally. The vaginal wall is thicker than that of the other portion of the oviduct and the luminal surface of the vagina showed thin longitudinally oriented mucosal folds [28,36]. The vagina of duck (*Anasboscas*) has average 3cm in length [37].

MATERIALS & METHODS

A total number of (10) females indigenous adult turkey hens (*Meleagris gallopavo*), these birds purchased from local supplier in Diala city, Iraq the age of these birds about (45-55) weeks. The average weight (5.5 kg). These birds were kept under normal conditions (outdoor) and given feed and water ad libitum for two weeks to eliminate whose have the signs of illness. All these birds were used for anatomical study. The female's indigenous adult turkey hens were weighted. The average weights of female chickens were (5.5 kg). The birds were anesthetized by using (25mg/ kg. B.W) ketamine hydrochloride, intramuscular injection and sacrificed. Then the abdominal feathers were removed. After the opening of the abdominal cavity, the genital tract is lifting out for the purpose of taking some parameters (weight and length). The total weight of the ovary and oviduct were taken by using sensitive digital balance. Estimated of the oviduct length was measured by measuring tape from infundibulum to end of the oviduct [38].

RESULTS & DISCUSSION

Ovary: In our present study, the ovary is developed from the left side, like other birds. It has an irregular surface, located in the abdominal cavity, and is related cranially to the caudal extremity of the lung, ventrally to the abdominal air sac and dorsally to the kidney andadrenal gland (Figure 1). Such observation were also [10] in Brown Kiwi, for whom that have two functional ovaries (right and left ovaries). The ovaries have mean weight 74.33±2.49gm and it shape as a cluster of various sized grapes corresponds to the mature ovarian follicles that range in size from 8-32mm in diameter, which project from the ventral surface of the ovary and are attaché by a pedicle (Figure 2).

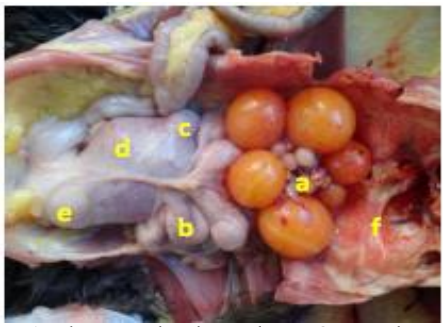

FIGURE 1: Photographs showed: a- Ovary b- Magnum c- Isthmus d-Uterus e- Vaginaf- Lung.

FIGURE 2: Photographs of Ovary (gross morphology) showed numerous rounded follicles of varying size

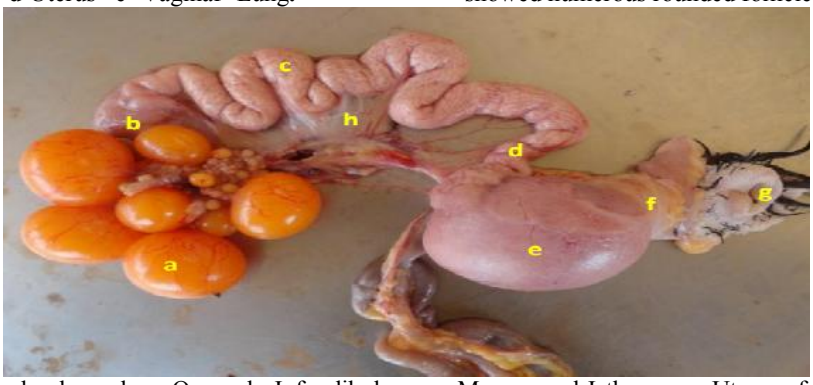

FIGURE 3: Photographs showed: a- Ovary, b- Infundibulum, c- Magnum, d-Isthmus, e- Uterus, f- Vagina, g- Cloaca, h- Ventral ligament of oviduct.

Oviduct: The study revealed that the turkey's oviduct has distinctive structural variation at different levels which subdivided into five principle part: Infundibulum, Magnum, Isthmus, Uterus and vagina. This result was compatible with results as reported in the domestic fowl by [3] and in rhea's by [26]. The oviduct in indigenous turkey hen like in other birds, is a highly-convoluted muscular duct with mean weight 59.66±1.52gm. It's extended from the left ovary to cloaca and fills most the dorsal and caudal part of the left side of the celomic cavity (Figure 1, 3). which transports the ovum from the ovary, with fertilization of the ovum and deposition of albumen, membranes and egg shell secreted on to the ovum to form the finished egg. It's suspended from the left side of the celomic cavity by a thin folded dorsal ligament which continues round the duct to form the ventral ligament. Both contain smooth muscle fibers. This study coincides with the result found by [18,19]. This result disagrees with results of [10], (in the domestic fowl. Infundibulum: is represented the first part of the oviduct, consists of two regions: a thin walled funnel-shaped portion with its opening and fimbria followed by a tubular portion (tubulus infundibularis), This result was agreement with [25] in Emu; [28] in the hen. The mean length of infundibulum is 15.82±0.5cm and comprises 18.01% of the length of the total oviduct. This result disagrees with result in Emu as 6.17cm [25], 7cm in laying hen [8,20]. This result coincides with [25] in Emu and [18] in laying hen.

Magnumis the largest and most coiled part of the oviduct, its wall is thick, folded with large diameter than the Infundibulum. The increase in average length and thickness of the wall due to increase in the thickness of tunica muscularis in its wall or by presence numerous tubular glands during egg production which responsible for synthesis and secretion of albumin (Figure 3). This result also as in laying hen[10], the mean length of the magnum was 36.31±0.6cm and comprises 41.35% of the length of the total oviduct. The mucosal folds of the magnum are characterized by their height especially in the cranial part but nearer to the isthmus, these mucosal folds decreased in their height and wideness (Figure 5). This result was similar to rhea's by [26] and in the domestic fowl by [30]. The boundary between the magnum and isthmus is clearly delineated by a narrow, translucent zone with no tubular glands (Figure 6). This result is also the same as in domestic fowl [13,10], but this result disagrees withch [25] in Emu, who stated that the zonula translucence is not observed in any of the emu oviducts. Therefore, to distinguish the isthmus from the magnum in the emu, the mucosal folds orientation and pattern is used for demarcation between the isthmus and magnum.

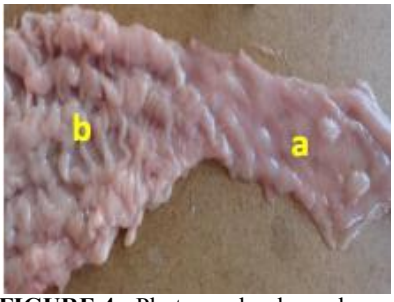

FIGURE 4: Photographs showed: a- Mucosal folds of infundibulum (tubular portion) b- Mucosal folds of magnum.

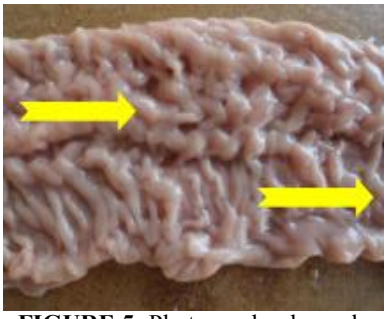

FIGURE 5: Photographs showed: Mucosal folds of the magnum (arrow

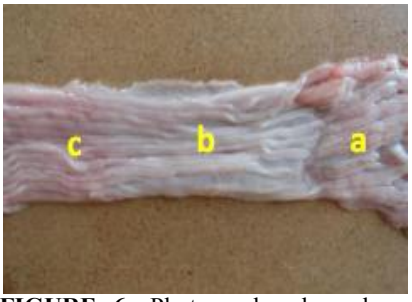

FIGURE 6: Photographs showed: a- Mucosal folds of the magnum b- Demarcation between the magnum and isthmus c- Mucosal folds of the isthmus.

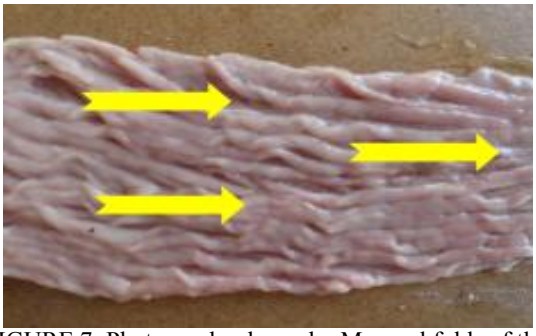

FIGURE 7: Photographs showed: Mucosal folds of the isthmus (arrow).

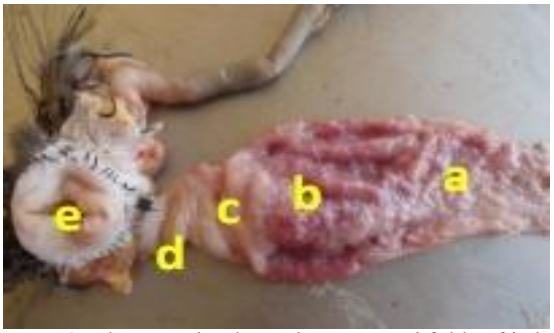

FIGURE 8: Photographs showed:a- Mucosal folds of isthmus b- Mucosal folds of the uterus c - Mucosal folds of vagina d- Curvature e- Cloaca.

Isthmus is a third region of the oviduct, this region appear similar to the magnum but thinner and less reduced than that of magnum in diameter (Figure 3). This result coincides with [3,10] in the laying hen. But this result disagrees with the result as reported by [25] in the Emu, who found that this region is similar in size to the magnum, however, It is significantly more narrow than uterus while in Ostrich is thicker than that in magnum and the muscular coat also a well-developed than magnum. It may be due to that the egg shell membranes in ostrich is more thicker than that in turkey hen where the isthmus is responsible on the composition of egg shell membrane around the egg white, the mean length of the isthmus is 14.91±0.6cm and comprises 16.97% of the length of the total oviduct. This result does not agree with the results as described in the Emu as 5.83±0.9cm [25,26] and 4 to 8 in the laying hen [10]. The mucosal folds of the isthmus are not as prominent as those of the magnum, narrower, less voluminous and had longitudinal orientation as the same orientation in the magnum (Figure 7). This result is also the same a in laying hen [8,22] and in rhea's [26].

Uterus showed very thick, muscular and distended wall terminated as a pouch to womb the egg during the period of shell formation between the isthmus cranially and vagina caudally. This result is also the same as in laying hen [8,22] and in the ostrich [28]. it has mean length 10.88±0.27cm and comparises 12.39% of the length of the total oviduct. This result does not agree with the result as described in duck as 7.70cm [32] and 16.0cm in rhea's [26]. The mucosal folds more complex than the isthmus with compressed and longitudinal orientation (Figure 8)

Vagina is the shorter part of the oviduct as S-shaped like structure serving as conduit connecting between the uterus and cloaca, for the egg mass at the time of position. This result corresponds with the result as reported in the domestic fowl by [33,34] in chicken and turkey. it has mean length 9.89±0.26cm long and comprises 11.26% of the length of the total oviduct. This result does not correspond with the result as described in Emu as 7.0±0.20cm [25], 11.5cm in rhea's rhea's [26] and 3cm in duck [37]. On other hand the study showed that the vagina of the turkey hen has one curvature (Figure 9) but two curvatures present in the domestic fowl by [3] and three curvatures in rhea's by[26].the mucosal folds are narrower than any other part of the oviduct except for the infundibulum due to absence of glands in this regions (Figure 8). This result is similar to the results obtained by [3] in the domestic fowl and [25] in rhea's.

REFERENCES

[1]. Yonju, H. T., Akira, S., Noboru and Kiyoshi, S. (2004) Changes in mRNA expression of the MMP-2 in the Mullerian duct of the chicken embryo. Gen. Comp. Endocrinol., 139:131-136.

[2]. Solomon, S. E. (1975) Studies on the isthmus region on the domestic fowl. Br. Poult. Sci., 16:225-258.

[3]. Hodges, R. D. (1974) Histology of the fowl, London. Academic Press. Pp: 344-349.

[4]. Blount, W. P. (1945) Sexing Day-old Chicks. 2nd ed. London, Poultry World, Ltd.(Cited by Getty,1975).

[5]. Nalbandov, A.V. and james, M. F. (1949)The blood-Vascular system of the chicken ovary. Am. J. Anat., 85:347-377.

[6]. Amin, S. O. and Gilbert, A. B. (1970) Cellular changes in the anterior pituitary of the domestic fowl during growth, sexual maturity and laying. Brit. Poult. Sci., 11:451-458.

[7]. Grau, H. (1943) Anatomie der Hausvogel. *In* Zeitzschmann, O. E. Ackernecht and H. Grau (ed.): Ellenberger and Baum's Vergleichenden Anatomie der Haustiere. 18thed. Berlin, Springer-Verlag.

[8]. Romanoff, A. L. and Romanoff, A. J. (1949) The Avian Egg. New York, John Wily and Sons, Inc., Pp:261-290.

[9]. Kinsky, F. C. (1971) The consistent presence of paired ovaries in the Kiwi (*Apteryx*) with some discussion of this condition in other birds ". Journal of Ornithology, 112(3):334-337.

[10]. King, A. S. and Mclelland, C. E. (1984) Birds: Their Structure and Functional ". 2nd Ed. Bailliers and Tindall. London. Pp: 145-165.

[11]. Fitzpatrick, F. L. (1930) Bilateral ovaries in Cooper's hawk with notes on kidney structure. Anat. Record., 46(4):381.

[12]. Pal, D. (1980) Histophysiology of reproduction in the domestic duck. Ph.D. Thesis, University of Calcutta, India.

[13]. Balachandran, A., Bhatnagar, M. K. and Geissinger,H. D. (1985) Scanning and transmission electron microscopic studies on the oviduct of pekin ducks fed methyl mercury containing diets. Scan. Electron. Microsc., 1:311-322.

[14]. Parto, P., Khaksar, Z., Akramifard, A. and Moghisi, B. (2011). The Microstructure of oviduct in Laying Turkey Hen as Observed by Light and Scanning Electron Microscopies. Wold Journal of Zoology, 6(2):120-125.

[15]. Abdel Mageed, A. M., Isobe, N. and Yoshimura, Y. (2009)Immunolocalization of avian B-defensins in the hen oviduct and their changes in the uterus during eggshell formation. Reproduction., 138:971-978.

[16]. Jung, J. G., Lim, W., Park, T. S., Kim, J. N., Han, B. K., Song, G. and Han, J. Y. (2011) Structural and histological characterization

[17]. \Getty, R. (1975) The anatomy of the domestic animals. 5th Ed. W. B. Saunders Company. 2:1935-1959Aitken, R. N. C. and Johnston, H. S. (1963) Observations on the fine structure of the infundibulum of the avian oviduct. J. Anat., 97:87-99.

[18]. Kern, D. (1963) Die Topographie der Eingeweide der Körperhohledes Haushuhnes (*Gallus domesticus*) unter besonderer Berücksichtigung derSerrosa-und Gekrösverhaltnisse. Inaug. Diss.,Universität Giessen. (Cited by Getty, 1975).

[19]. Curtis, M. R. (1910) The ligaments of the oviduct of the domestic fowl. Bull. Maine agric. Exptl. Sta., 176:1-20. (Cited by Getty, 1975).

[20]. Giersberg, H. (1922) Untersuchungenuber Physiologie und Histologie des Eileiters der Reptilien und Vogel : nebsteinem Beitragzur Fasergenese. Z. wiss. Zool., 120:1-97.

[21]. Kar, A. B. (1947) Studies on the ligaments of the oviduct in the domestic fowl. Anat. Rec., 97:175-192.

[22]. Aitken, R. N. C. and Johnston, H. S. (1963) Observations on the fine structure of the infundibulum of the avian oviduct. J. Anat., 97:87-99.

[23]. Aitken, R. N. C. (1971) The Oviduct. *In* Bell, J. D. and Freeman, B. M. (eds.) Physiology and Biochemistry of the Domestic Fowl.Vol. 3. London, Academical Press, Pp:1237-1289.

[24]. Fujii, S. (1963) Histological and histochemical studies on the oviduct of the domestic fowl with special reference to the region of uterovaginal juncture. Arch. Histol. Jap. 23:447-459.

[25]. Robert, B., Reed, J., Lee, A., Cope and James, T. and Blackford (2011) Macroscopic Anatomy of the Reproductive Tract of the Reproductively QuiescentFemale Emu (*Dromaius novaehollandiae*). Anat. Histol. Embryol., 40:134-141

[26]. Parizzi, R. C., Santos, J. M., Oliveira, M. F., Maia, M. O., Sousa, J. A., Miglino, M. A. and Santos, T. C. (2008) Macroscopic and microscopic anatomy of the oviduct in the sexually mature rhea (*Rhea americana*). Anat. Histol. Embyol., 37(3):169-176.

[27]. Muwazi, R. T., Baranga, J., Kayanja, F. I. B. and Schliemam (1982) The oviduct of the ostrich (*Struthiocamelus massacus*). Journal of Ornithology., 123:424-433.

[28]. Saber, A. S., Emara, S. A. M. and Abosaeda, O. M. M. (2009) Light, Scanningand Transmission Electron Microscopical Study on the Oviduct

of the Ostrich (*Struthiocamelus*) . J. Vet. Anat., 2(2):79-89.

[29]. Jamieson, B. G. M. (2007) Reproductive Biology and Phylogeny of Birds. Science and Publishers. Australia. Vol.6 Pp: 166-191.

[30]. Wyburn, G. M., Johnston, H. S., Draper, M. H. and Davidson, M. F. (1970) The fine structure of infundibulum and magnum of the oviduct of *Gallus domesticus*. Q. J. Exp. Physiol., 55:213-232.

[31]. Wolford, J. H., Ringer, R. K. and Coleman, T. H. (1964) Ovulation and egg formation in the Beltsville Small White Turkey. Poult. Sci. 43:187-189.

[32]. Mohammadpour, A. A., Zamanimoghadam, A. and Heidari, am. (2012) Comparative histo-morphometrical study of genital tract in adult laying hen and duck. Veterinary Research Forum 3(1): 27-30.

[33]. Bakst, M. R., Wishart, . J. and Brillard, J. P. (1994) Oviducal sperm selection, transport, and storage in poultry. Poult. Sci. Rev., 5:117-143.

[34]. Jacobs, M. and Bakst, M. R. (2007). Developmental anatomy of the female reproductive tract. Pages 149-179 in Reproductive Biology and Phylogeny of Aves (Birds). Jamieson, B. G. M. ed. Science Publishers, Enfield, NH.

[35]. Madekurozwa, M. C. (2008) A gross anatomical and histomorphological study of the vagina of the emu *(Dromaiusnovaehollandiae)* and ostrich (*Struthiocamelus*). Aus. J. Exp. Agri., 48:1332-1337.

[36]. Bezudenhout, A. J., Soley, J. T., Groenewald, H. B. and Burger, W. P. (1995). Sperm- storage tubules in the vagina of the ostrich (*struthiocametus*). Ondersteeport J. Vet. Res., 62:193-199.

[37]. Das, L. N. and Biswal, G. (1968) Microantomy of the reproductive tract of the domestic duck (*Anasboscas*)., Ind. Vet. J., 45:1003-1009.

[38]. Vernerova, E. and Firmanova, V.(1985). The need for managemental measures taking into account the two stages of development of sexual organ in female turkey. ZivocisnaVyroba., 42:293-305.