

A Comparative Histological Study of The Female Reproductive System in Two Types of Amniotic Animals

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Abstract

The research aims to conduct a comparative histological study of the female reproductive system in two types of amniotes that live in the Iraqi environment include the local rabbit and the Japanese quail. The study was conducted from 3/1/2021 to 21/5/2021 in the College of Agriculture, Anbar University, and the College of Education for Pure Sciences, Anbar University. After the animals were dissected, tissue sections were prepared for all parts of the reproductive system in birds and rabbits and examined for comparison. The study showed that the female reproductive system in birds consists of a single ovary with a shape similar to a grape cluster consisting of some ovarian follicles and a genital duct consisting of the funnel, magnum, isthmus, uterus, and vagina. As for the female reproductive system in rabbits, it consists of a pair of oval-shaped ovaries and an egg duct consisting of the ampulla and isthmus, as for the uterus, it is of a bicornuate type, connected by the cervix and the vagina on the lower side. The study showed that there are many differences in the shape and structure of the ovaries and oviducts in rabbits and quails, and this is due to the differences in their reproductive functions (viviparous or oviparous, respectively).

Keywords: Reproductive organs, Rabbit, Quail.

Introduction

The reproductive system is the system responsible for the continuation and survival of the species through the reproductive process. As successful birth and healthy offspring depend on the female reproductive system. The female reproductive system regulates the maturation of the eggs, and provides the appropriate environment for the process of fertilization and implantation of the embryo, in addition to ensuring that the appropriate nutrition is obtained so that the fetus grows (Chumduri and Turco, (2021). The continuity and success of a species of a living organism depend on how well it is adapted to the environmental location in which it lives. Therefore, the species that are exposed to risks must produce a large number of individuals to keep an appropriate number of them to ensure the survival of the species. The female reproductive system consists of a pair of ovaries, which produce female reproductive cells known as ova or eggs and produce hormones that regulate reproductive function and secondary sexual characteristics. The oviduct, which transfers the eggs to the uterus after ovulation, and the uterus, which includes the site of embryo implantation and the occurrence of pregnancy and the cervix, as it works first to facilitate the entry of sperm and thus, the

fertilization process occurs and, secondly, it acts as a barrier that protects the upper part from the entry of pathogens (Nott et al., 2016). Finally, the vagina, which extends from the cervix to the vulva, is characterized by the presence of mucous folds that facilitate the birth process in addition to preventing pathogens from reaching the uterus (Nucci et al., 2019). Amniotic animals, which are represented by a group of four-legged animals such as reptiles, birds, and mammals, are characterized by laying eggs that are very adapted to survive in the land environment. The egg consists of four membranes: the amniotic membrane, the allantoic membrane, the placenta, and the yolk sac. The amniotic membrane neutralizes the fetus with a fluid that acts as a cushion and provides a suitable watery environment in which it can grow. As for the allantoic membrane, it is a bag that contains metabolic waste. The placenta surrounds the egg contents and along with the allantoic membrane helps the fetus to breathe by providing oxygen and getting rid of carbon dioxide. Finally, the yolk sac in some amniotic species contains a nutrient-rich fluid (called the yolk) that the fetus consumes during its development. The eggs are placed in a hard and metallic shell, but this shell is flexible as the shell provides physical protection for the fetus and limits water loss. Some amniotes produce eggs without a shell, as in all types of mammals and some types of reptiles, as the fetus develops inside the female reproductive system (Akmal, 2016).

Materials and methods of work

Experimental animals

The experiment was conducted from 3/1/2021 to 21/5/2021 in the College of Agriculture and the College of Education for Pure Sciences at the University of Anbar. Two types of amniotes were used from what is available in the Iraqi environment:

- 1- 20 female *Coturnix coturnix* Japanese quail as an example of a bird. Obtained from the College of Veterinary Medicine, University of Baghdad. They are 16 weeks old, with an average weight of 145.5 ± 34.341 g. The animals were raised under laboratory conditions at a temperature of 21 °C. The light duration as standard, as it was 16 hours light and 8 hours darkness.
- 2- 20 female local rabbits, *Oryctolagus cuniculus*, as an example of a mammal. Obtained from Dolphin Veterinary Clinic/ Al-Ramadi, at the age of two years, with an average weight of 1438.5 ± 284.988 g.

The animals were dissected, the reproductive system was excised, and the organs were preserved with 10% formalin solution as a fixative solution to prepare them for tissue sections.

Preparation of 10% formalin solution

The solution was prepared by adding 100 ml of 40% formaldehyde solution to the 900 ml of tap water.

Tissues Preparation

Tissue sections were prepared from all parts of the female reproductive system, for both quails and rabbits. The samples were fixed with 10% formaldehyde solution for 24 hours, after which the dehydration process was carried out by withdrawing water from the samples using a phase of ethyl alcohol with concentrations of 100%, 90%, 70%, 50% twice, then clarification was carried out with a solution of xylene and then embedded with paraffin wax at a melting temperature of 54 C°, then it was poured into molds with paraffin wax at a temperature of 62 C°, which in turn was cut into microtomes with a thickness of 5 µm. After obtaining the slides, they were placed in a water bath at 45°C, then fixed on the slides by Mayers albumin and then stained with hematoxylin and eosin dye.

Results and discussion

Coturnix coturnix Japanes

It is known that the left ovary is the one that remains after the completion of the embryonic growth processes in the adult and has variable shapes and consists of many follicles of variable sizes that gave a shape similar to grape clusters. The study results showed that the left ovary consists of two distinct regions: the outer cortex and the inner medulla. The cortex consists of collagen bundles and smooth muscle fibers, in addition to many follicles in different stages of growth. The pulp consists of vascular connective tissue, nerves, and smooth muscle fibers as shown in Fig (1). The study showed that the mature ovarian cortex overlaps with the pulp, but it can be distinguished by the activity of the cortex cells being more basal, while the pulp cells are more acidic and this is similar to the study of (Denise et al ., 2017) on the ovary of laying hens. The study showed that the primary follicles were multiple and appeared to be composed of central oocytes surrounded by 3-4 layers of granulosa cells. Secondary follicles appeared larger and showed the presence of large single oocytes surrounded by several layers of granular cells that appeared arranged in groups to form the small cavity containing fluid. As for the mature follicles (griffin), they appeared to contain large yolk-laden oocytes characterized by round nuclei. The egg is surrounded by several structural layers: the plasma membrane (periviteline layer), granulosa cells, good internal blood vessels, and external fibrous vessels as in Fig (1). These results were similar to the study carried out by (Sura, 2017) on the barn owl and (Mohammad et al., 2021) on the Turkish bird (Al-Taai, 2015), as they mentioned that the ovarian follicle consists of concentric layers.

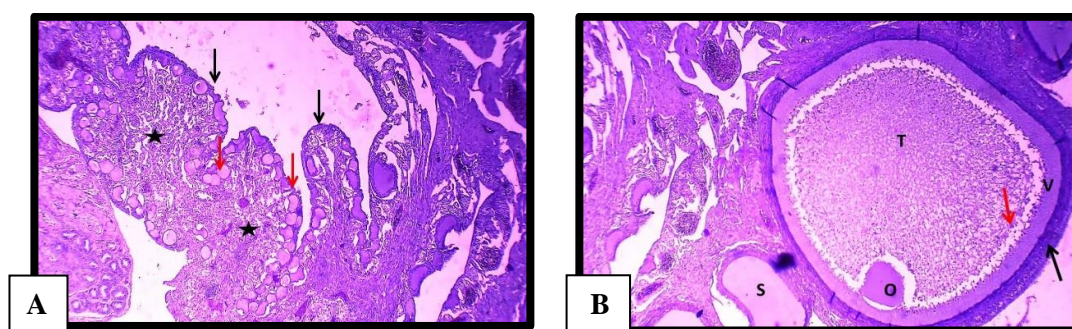


Fig 1: histological section of the left ovary (Adult quail) Shows: (A.) shows (Red arrows) cortex with numerous primary follicles, (asterisk) Medulla. (B.) (S) secondary follicle, (T) graffian follicle with (Red arrows) yolk granules, (V) perivitelline plasma membrane, (Black arrow) granulosa cells layer, (O) oocytes. H&E stain, 40x

Oviduct

The study showed that the oviduct is characterized by containing all types of tunica (the tunica mucosa, submucosal, muscular, and adventitia) well distinguished except for the funnel region.

Infundibulum

The first part of the funnel has a thin wall and the tunica mucosa contains many long mucous folds. These primary folds subdivide into many secondary folds as in Fig (2). Mucosal folds are lined by ciliated simple columnar epithelium and pseudo stratified columnar epithelium. In the region of the funnel, the lamina propria is composed of loose connective tissue Fig (2C). The submucosal tunica was a vascular connection tissue. The tunica muscularis consists of two layers of cells, the first inner circular and the outer layer consisting of smooth muscle fibers. These results were similar to the study conducted by (Sharaf et al., 2012) in the ostrich and (Mohammed, 2010), in geese, but it differs from the study of (Sukhadeve et al., 2019), which showed that the mucous tunica in Punjab white quail consists of columnar ciliated epithelial tissue, and the lamina propria was of a simple columnar type with an oval to rounded core basal site.

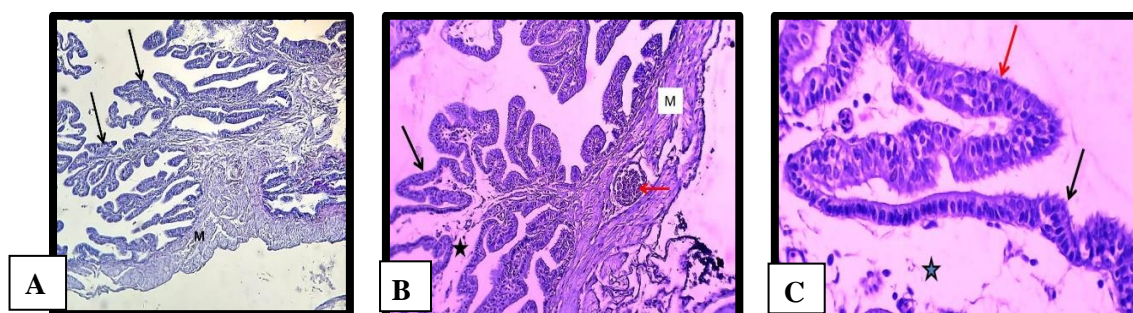


Fig2. : (A). **Longitudinal section in funnel of infundibulum (Adult quail)** shows (Arrows) branched mucosal folds & (M) smooth muscle fibers. (B). shows (Black arrows) branched mucosal folds, (asterisk) lamina propria, (Red arrow) blood vessel & (M) smooth muscle fibers. H&E stain. 10x. (C) **Magnified section in funnel of infundibulum mucosa** shows (Black arrow) ciliated columnar epithelium, (Red arrow) ciliated pseudo stratified columnar epithelium (Asterisk) loose connective tissue of lamina propria. H&E stain. 40x

Magnum

The study showed that the magnum region is characterized by the widest cavity, which is crowded with huge mucous folds similar to leaves with short simple folds between them. The increase in diameter is mainly due to the increase in the thickness of the mucous layer Fig (3A,B). The folds of the magnum are lined by a pseudo- stratified columnar epithelium consisting of ciliated and non-ciliated cells with basal cells. Non-ciliated cells possess a

benthic nucleus site. The ciliated cells are characterized by the dark pigmented cytoplasm, while the basal cells are arranged on the basement membrane Fig (3A). The lamina propria is a loose connective tissue containing the compound glandular alveoli tubular glands. The mucous glands are composed of glandular alveoli, each lined by columnar cells containing a large basal-site core Fig (3A). The tunica submucosa is a thin layer of vascular connective tissue that extends into the center of the lamina propria. The tunica muscularis is composed of two layers of longitudinal and circular smooth muscle fibers separated by a loose vascular connective tissue (Fig. 3A). The stratified pseudo-columnar epithelial cells in the oviduct of the quail are similar to those found in the owl (Sura, 2017). (Berg et al., 2001) also found in a study on Japanese quail that the epithelium is simple columnar cells. (Hassan, 2013 ; Sharaf, 2012) showed that the mucosa is composed of columnar stratified pseudo-columns consisting of ciliated and non-ciliated cells. This difference in cell shapes is due to the fact that estrogen secreted by granule cells may stimulate epithelial stem cells to form three types of morphologically different cells which are tubular cells, ciliated cells, and goblet cells (Al-Taai, 2015).

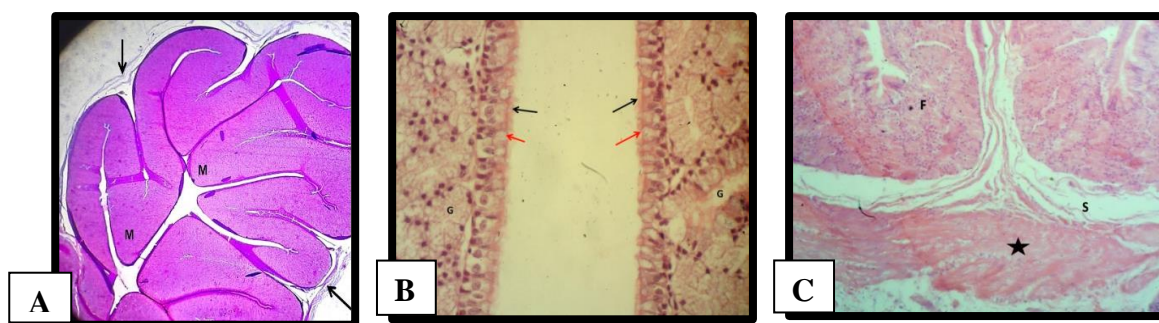


Figure 3: The magnum region of adult quail shows: (A). (M) numerous long mucosal folds & tunica muscularis. 4x (B). : magnified section of magnum folds of adult quail shows (Black arrows) ciliated cells, (Red arrows) non-ciliated cells & (G) compound tubular glands. 40X. (C). shows (F) base of mucosal fold, (S) tunica submucosa & (Asterisk) circular smooth muscle fibers H&E stain.10x

Isthmus

The results showed that the mucous layer of the isthmus contains simple mucosal folds Fig (10). These folds were lined by a pseudo stratified columnar epithelium composed of three types of cells: ciliated cells, non-ciliated cells (goblet cells), and basal cells Fig (4). The lamina propria showed that its structure is similar to what is found in magnum, as it contains mucous glands Fig (4). As for the tunica muscularis, it contains the same components found in magnum Fig (4). The adventitia is composed of dense collagenous connective tissue covered with mesothelium. The current study results were similar with many studies that showed that the epithelium of the isthmus is similar to the epithelium of magnum, but other studies showed that the simple columnar ciliated epithelium contains goblet cells (Parto et al., 2011; Sultana et al., 2003; Ozen et al., 2009).

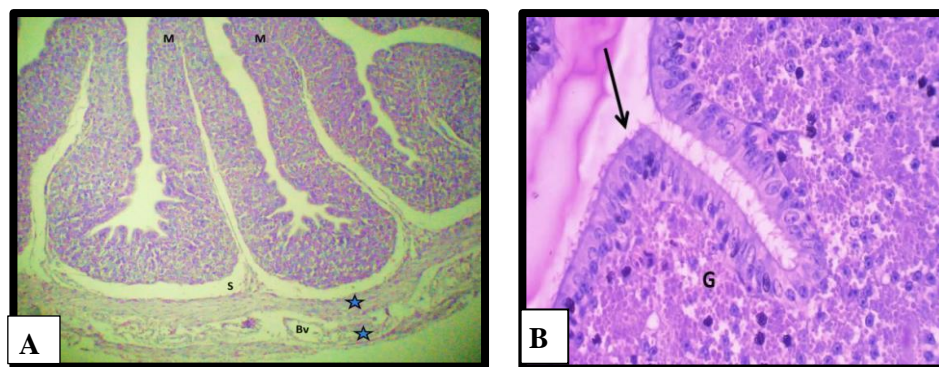


Figure 4: The isthmus region of adult quail shows (A). (M) numerous longest mucosal folds, (S) submucosa, (Bv) blood vessels & (Asterisks) layers of tunica muscularis. H&E stain.10x. (B). **magnified section of isthmus folds of adult quail** shows (Arrow) epithelium and mucosal glands (G).H&E stain. 40x

Uterus

The study in the uterus of adult quail showed that the mucous membrane contains the heaviest and longest branched mucous folds Fig (5). All these folds are lined by pseudo stratified columnar epithelium Fig (5). The lamina propria of the mucosal folds contains many mucous glands, which consist of compound tubular glands. The tunica muscularis in the uterus was very thick and consisted of three layers of smooth muscle bundles: a thick inner circular layer, a transparent middle layer and an outer longitudinal layer. These three layers are separated from each other by loose vascularized connective tissue Fig (5). The uterus region is characterized by containing a greater number of mucous folds compared to other regions of the oviduct, because the uterus plays an important role in the deposition of inorganic compounds to form the crust, as this process requires more time up to 18-26 hours and therefore the number of folds and surface area very important. Also, the tunica muscularis increased its thickness in the uterus and vagina region more than the rest of the oviduct regions because these two regions have dealt with the size of completed egg, which requires good muscle contraction in order to complete the egg-laying process. This result was supported by the opinion that in birds the laying of eggs is controlled by arginine vasotocin, which causes uterine contraction, by stimulating the production of uterus prostaglandins, the latter causing uterus contractions (Al-Taai, 2015). The study results were similar to the study by (Sura, 2017), which showed that the pseudo stratified columnar epithelium consists of three types of cells (goblet cells, non-ciliated and basal cells). The tunica muscularis consisted of three layers, and this is in line with the study of (Al-Taai, 2015) on Mallard ducks, but it contradicts the results of (Lucy and Harshan, 2011) who showed that the tunica muscularis in chickens consists of two layers of smooth muscle bundles.

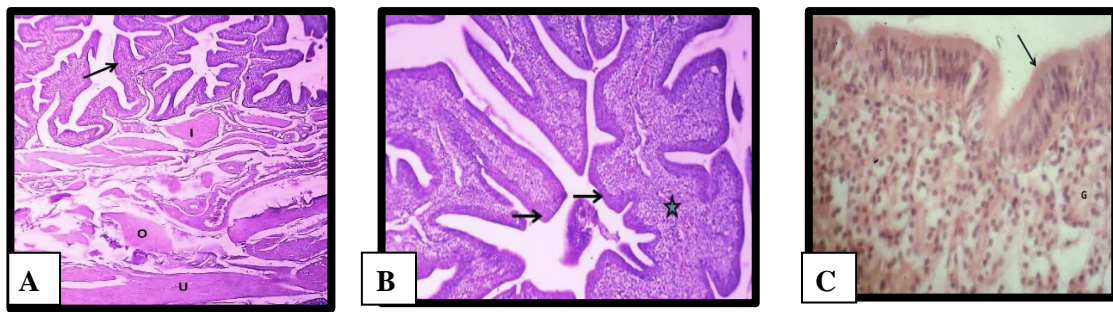


Fig.5: The section uterus region shows. (A). (Arrow) shows branched mucosal folds, (I) inner circular smooth muscle fibers, (O) oblique smooth muscle fibers, (U) outer longitudinal smooth fibers. H&E stain. 40x. **(B). The section uterus folds shows** (Arrows) shows branched mucosal folds, (Asterisk) compound tubular glands. H&E stain. 10x. **(C). magnified section of uterus folds of adult quail shows** (Arrow) epithelium and mucosal glands (G).H&E stain. 40x.

The Uterovaginal junction

The uterovaginal junction of a mature quail is located between the uterus and the vagina. This region can be distinguished by its thick wall and the basal lamina in its mucosal layer being non-glandular. The mucous layer is lined with a pseudo stratified columnar epithelium that contains many crypts that extend into the basal lamina and arrange to form tube-like structures that play an important role as a site for storing sperm called spermatozoon storage tubules (SST) Fig (6). The tunica muscularis in this area is considered an extension of the bundles, as it consists of three layers of smooth muscle bundles: a circular thick inner layer, a transparent middle layer and a longitudinal outer layer, each of these layers is separated from the other by an epithelial tissue supplied with blood vessels.

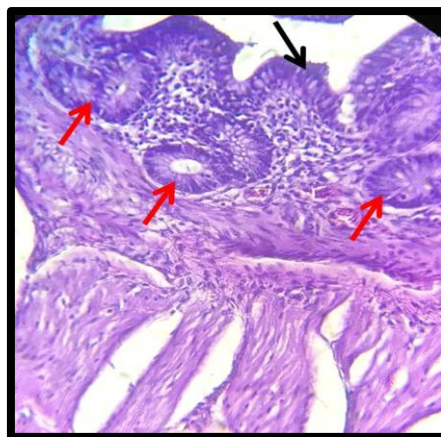


Fig.6: The section uterovaginal junction shows (Black arrows) epithelium, & (Red arrow) sperm storage tubules. H&E stain. 40x

Vagina

The study showed that the vagina is a small area that opens in the cloaca and is characterized by the thickness of its wall. Mucous folds are simple folds. Most of these folds are lined by a pseudo stratified columnar epithelium on the lamina propria. The submucosal layer is

composed of loose, non-glandular epithelial tissue Fig (7) and the muscular tunica of the vagina is similar to that of the uterovaginal junction. These results are similar to the study by (Ferdous et al., 2011) on mature chickens and (Hanaa et al., 2017) on geese.

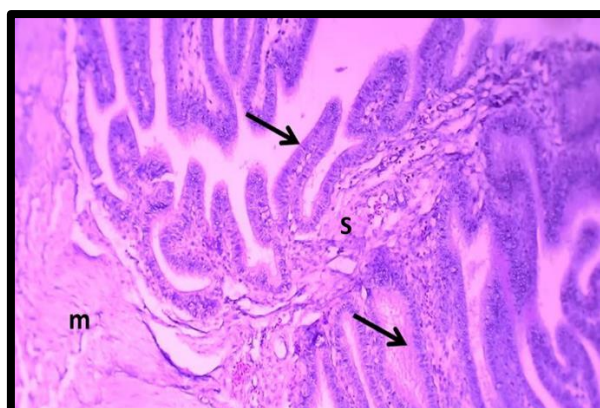


Fig7: Mucosal fold of vagina in adult quail shows (Arrows) simple not branched mucosal folds, (S) submucosa & (M) muscularis. H&E stain, 10x

Histological study of the female reproductive system of the rabbit *Oryctolagus cuniculus*

Ovary

The current study showed that the ovaries consist of two regions: the outer region of the ovary represents the cortex, which is covered by a layer of germinal epithelium, and the second layer is inner and is known as the medulla Fig (8). The ovary contains many follicles in different stages of maturation, which include: primordial follicles, primary, secondary, and tertiary or Griffin follicles. The study showed that all of these follicles are supported by a dense tissue of stromal cells (the type of connective tissue cells that work to support the cells in that organ) as shown in Fig (8). The sub epithelial tissue called Tunica albuginea, which consists of a thin layer of collagen fibers Fig (8,10). The ovary of the pulp is composed of loose connective tissue rich in blood vessels and nerve fibers Fig (8).

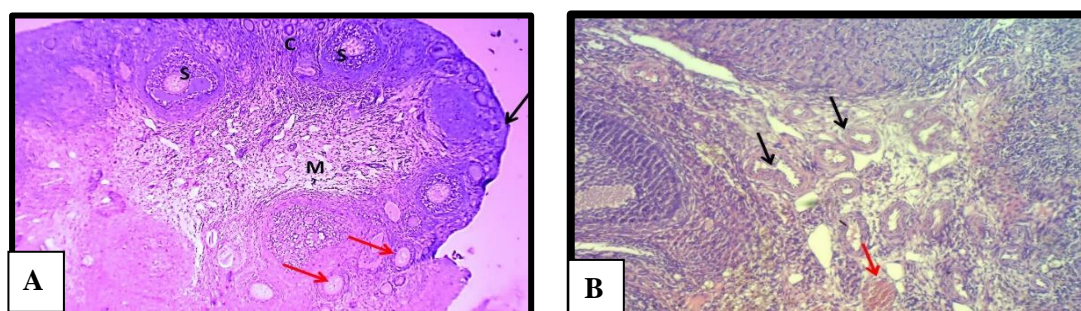


Figure 8: section of ovary (Rabbits doe) shows: (A). (Black arrow) Germinal epithelium, (C) Cortex, (M) Medulla, (Red arrows) primary follicle , (S) Secondary follicle .H&E stain 40x. (B). Section of ovarian medulla (Rabbits doe) shows: (Black arrows) Arterioles & (Red arrows) venule. H&E stain 40x.

The primordial follicles lie below the tunica albuginea to form with the primary follicles a series of small developing follicles, the primordial follicles being the smallest and having the smallest oocyte, the smallest diameter and surrounded by one or two layers of squamous cells Fig (9,10). Furthermore, the primary follicles, which represent the second group of cortical follicles, appear in two types, early and late primary follicles. Early follicles (the smallest follicles) contain slightly large oocytes, surrounded by 2-3 layers of cuboidal granulosa cells and surrounded by active fibroblasts Fig (9). The late primary follicles are larger than early follicles, containing large oocytes surrounded by 10-15 layers of granulosa cells Fig (10). The secondary follicles are large, containing a centrally located oocyte composed of many layers of granulosa cells that are separated by numerous cavities of varying size. The outer layer of this follicle is fibrous and known as theca externa fibrous. The inner layer is vascular and known as the vascular theca interna (Fig. 9). Whereas, the tertiary follicles, the largest ovarian follicles types, possesses an oocyte that is not centrally located. The oocyte is surrounded by a thin layer of granular cells to form the corona radiate and the follicle contains one wide cavity called the antrum, granulosa cells consist of a thin layer, the outer layer of follicle consists of the theca externa fibrous and the vascular theca interna Fig (10). These results were similar to the findings of (Al-Dahhan 2015 ; Ishaya 2018 ; Sura 2017) about the structure of the ovaries and follicles of all kinds.

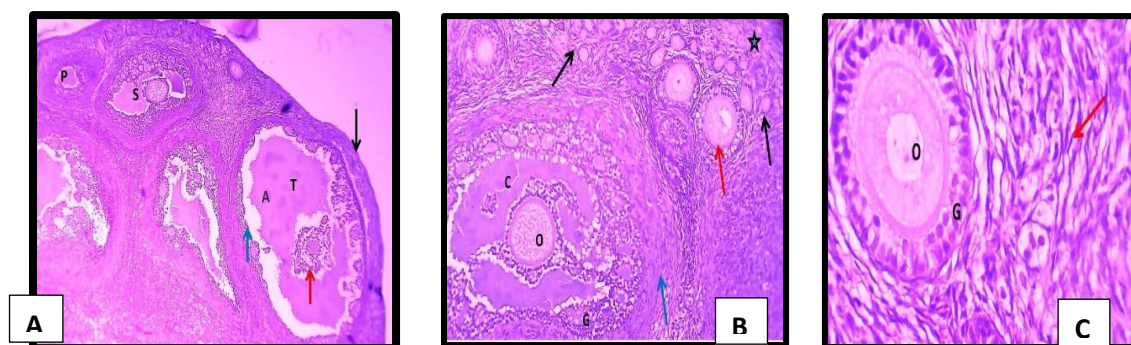


Figure 9: section of ovary (Rabbits doe) shows (A). (Black arrow) germinal epithelium, (T) tertiary follicle, (P) primary follicle & (S) Secondary follicle, (A) antrum, Red arrow) small oocytes surrounded by granulosa cells forming corona radiata & (Blue arrow)) theca layers H&E stain 40x. **(B).** (Asterisk) fibrous tunica albuginea, (Red arrow) early primary follicle, (Black arrows) Primordial follicle,(Blue arrow) theca layer of secondary follicle, (O) oocyte , (G) granulosa cells layer &(C,) numerous cavities H&E stain 10x. **(C).** Section of early primary follicles (Rabbits doe) shows: (O) oocytes of early primary follicle, (G) 2-3 layers of granulosa cells layers, (Red arrow) stromal like fibroblast cells. H&E stain 40x.

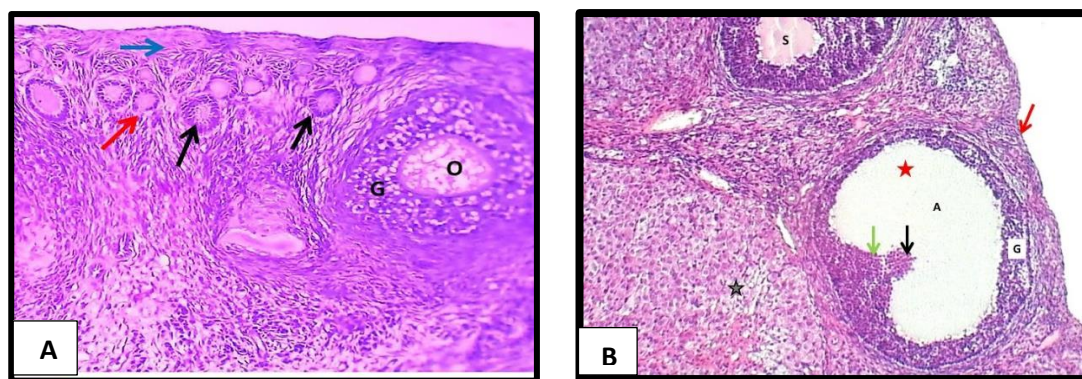


Figure 10: Section of cortex (Rabbits doe) shows: (A). (Red arrows) Primordial follicles, (Blue arrow) Tunica albuginea, (O) Oocytes of late primary follicle, (G) Numerous granulosa cells. H&E stain 40x. **(B).** section of tertiary follicle shows: germinal epithelium (Red arrow), tertiary follicle (Red asterisk), oocytes (Black arrow), granulosa cells (G) & antrum (A), corona radiata (Green arrow), corpus letium (Black asterisk).H&E stain 10x.

Oviducts (Fallopian tube)

Infundibulum funnel

The study showed that the funnel has a very wide cavity and the superficial mucous layer is very crowded with finger-like structures called Fimbria (Fig. 8). The Fimbria are lined with a pseudo stratified columnar epithelium consisting of a few cells that secrete mucus and many ciliated cells Fig (11). This is similar to what was reported by (Ozen et al., 2010) in rabbits and (Mokhtar, 2015) in cows indicated the presence of pseudo stratified columnar epithelium, while (Adelaja and Polycarp, 2012) indicated that the epithelium lining the funnel is simple cubic while (Pereda et al., 2006) indicated that there are both columnar and cubic types. The lamina propria-submucosa is formed by fibromuscular connective tissue Fig (11B). The tunica muscularis consists of two layers of smooth muscle: inner circular and outer longitudinal Fig (11C).

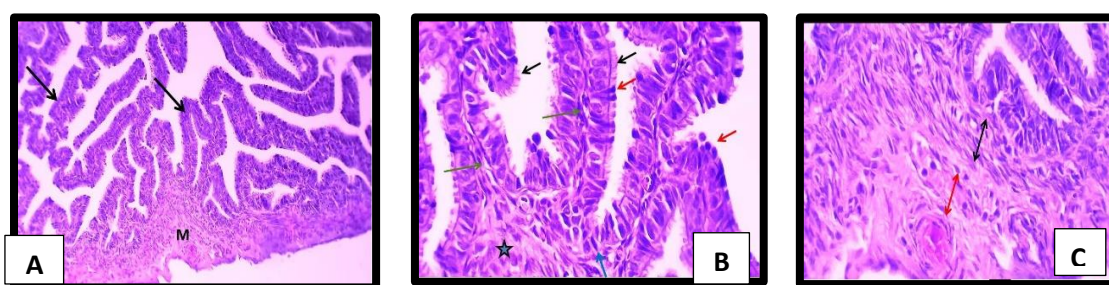


Figure 11: Section of the infundibulum (Rabbits doe) shows: (A). (Black arrows) Very wide lumen with furthermore branched mucosal folds & (M) tunica muscularis. H&E stain 10x. **(B).** Section of fimbria of Infundibulum shows: (Red arrow) secretory cells, (Black arrows) non-secretory ciliated cells, (Blue arrows) peg cells, (Green arrows) lamina propria & fibro muscular core (Asterisks). H&E stain 40x. **(C).** Section of wall of the infundibulum

shows: (Black double head arrow) inner circular & (Red double head arrow) outer longitudinal smooth muscle fibers. H&E stain 40x.

Ampoule

The study results showed that the ampoule contains a very wide cavity and the tunica mucosa shows many simple and branched long mucous folds in addition to the presence of short folds between the long folds Fig (12). The study results observed that the mucosal folds are lined with pseudo stratified columnar epithelium. This epithelial tissue consists of three types of epithelial cells: mucous secretory cells, ciliated non-secretory cells, and peg cells, which are non-ciliated epithelial cells believed to be the maturation stage of non-ciliated secretory cells. The mucous secretory cells are few in number and contain a cytoplasm rich in blood vessels, which reflects their secretory nature. The non-secretory ciliated cells are numerous with an elongated nucleus, the cytoplasm is acidic and reveal the presence of thick, mucous-covered cilia. As for the peg cells, they are few in number and settle on the basement membrane, and they can be distinguished by the dark pigment of the cytoplasm and the nucleus is elongated Fig (12). The tunica muscularis consists of two layers of smooth muscles, the inner layer being circular and the outer layer being elongated as in Fig (12).

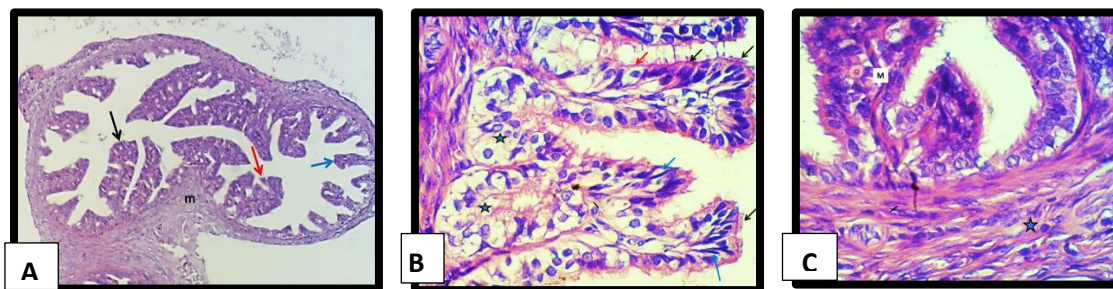


Figure 12. Section of the ampulla (Rabbits doe) shows: (A). (Black arrows) simple mucosal fold, (Red arrow) branched fold, (Blue arrow) short mucosal fold (S) & tunica muscularis (M).H&E stain 40x. (B). Section of mucosal fold of ampulla shows: (Red arrow) secretory cells, (Black arrows) non-secretory ciliated cells, (Blue arrows) peg cells & epithelial crypts (Asterisks).H&E stain 40x. (C). Cross section through the all of the ampulla shows: (M) mucosal fold, (Asterisk) circular smooth muscle bundles. H&E stain 40x.

Isthmus

The study results explained that the isthmus represents the narrowest region in the oviduct, moreover, the tunica mucosa is characterized by having a few to medium numbers of short and simple mucous folds as in Fig (13). The mucous folds are lined with small cuboidal to columnar epithelial tissue. The lamina propria-submucosa consists of a thin layer of cellular connective tissue. The tunica muscularis consists of a very thick layer of circular smooth muscle fibers Fig (13).



Figure 13: Section of the isthmus (Rabbits doe) shows: (Black arrows) simple short mucosal fold & tunica muscularis (M).H&E stain 40x.

Uterus

The study results showed that the uterus has a very thick wall that is well characterized into three regions: endometrium, myometrium, and perimetrium Fig (14). The inner layer consists of a smooth surface without folds and covered with a layer of simple columnar epithelial tissue and cytoplasm of acidic type. The lamina propria of the inner layer is composed of loose connective tissue that can be distinguished by containing simple uterine glands that are lined with simple cubic epithelial tissue Fig (14). This result agrees with (Veras et al., 2009) in brown monkeys, but it differs with (Al-Dahan, 2015) in rabbits, and this is due to the different species. The muscular tunica of the uterus consists of two very distinct thick layers of smooth muscle fibers, an inner circular muscle layer and a longitudinal outer layer separated from each other by loose connective tissue rich in blood vessels as shown in Fig (17). This is similar to the study by (Sura, 2017 and Lopes et al., 2017).

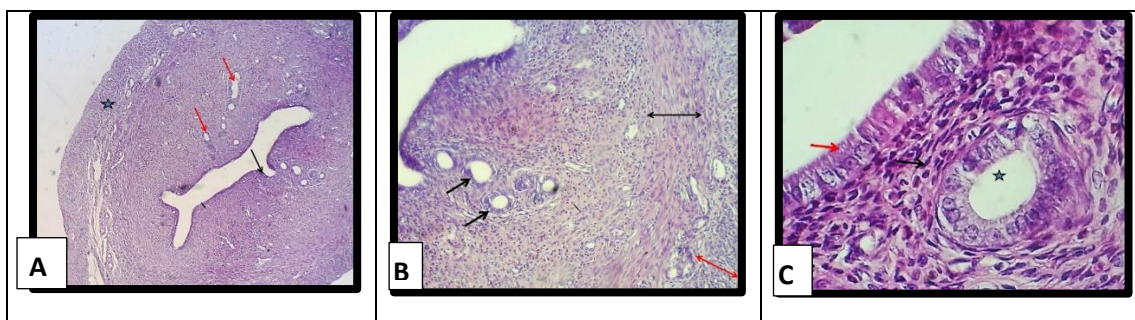


Figure 14: Section of uterus (Rabbits doe) shows: (A). (Black arrows) endometrium, (Red arrows) uterian glands & (Asterisks) myometrium .H&E stain.40x. **(B).** Section of endometrium shows: (Black arrows) uterine glands, (Black double head arrows) inner circular smooth muscle fibers, & (Red double head arrows) outer longitudinal smooth muscle fibers. H&E stain 10x. **(C).** simple columnar epithelial (Red arrows), fibroblast of cellular connective tissue (Black arrow) & uterian glands (Asterisk) .H&E stain 40x.

Cervix:

The study results observed that the cervix is characterized by a thick wall and the mucous layer contains branched mucous folds and simple short folds found between the branching

folds Fig (18). The mucous folds are covered by a pseudo stratified columnar epithelium tissue consisting mainly of mucosal secretory cells and basal cells Fig (19). These results are consistent with (Veras et al., 2009) but differs with (Sura, 2017 ; Lopes et al., 2017) who showed that the cervical epithelium is a simple columnar epithelium consisting of ciliated cells and non-ciliated mucus secretory cells (goblet cells), it is due to the different types. In each fold, the lamina propria contains collagenous connective tissue rich in blood vessels Fig (19). The tunica muscularis is composed of a very thick layer of smooth muscle fiber bundles arranged in a circular motion.

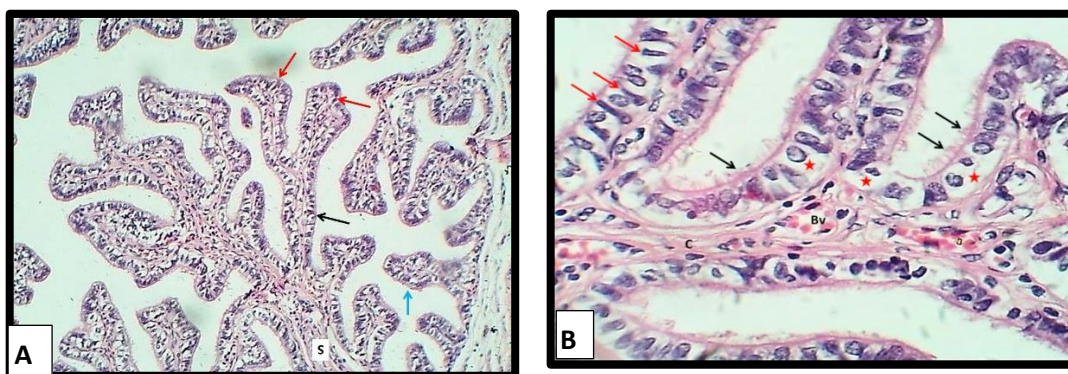


Figure 15: Section of cervix (Rabbits doe) shows: (A). simple mucosal folds (S), primary folds (Black arrows), secondary folds (Red arrows) & short mucosal folds (blue arrow) .H&E stain.10x. **(B).** collagen fibers (C.), blood vessel (Bv), ciliated epithelial cells (Black arrows), peg cells (Red arrows) & mucous secreting cells (Red asterisks) .H&E stain.40x.

Vagina

The study results showed that the vaginal wall is very thick and consists of four regions: the mucosa, submucosa, muscularis, and the adventitia Fig (16). The tunica mucosa of the vagina contained simple mucous folds lined with stratified squamous tissue. The submucosal tunica is characterized as a very thick layer of dense, irregular collagenous connective tissue that contains many blood vessels. The tunica muscularis appeared as a thin layer consisting of a thin layer of circular skeletal muscle bundles and an outer layer of longitudinal muscles Fig (16). These results were similar to the study presented by (Al-Saffar et al., 2018) and (Oh et al., 2003) on local rabbits, but it was in contrast to the study of (Sura, 2017), which showed that the vagina in the wild rabbit consists of three layers: the mucous membrane of the tunica muscularis and the adventitia. The mucous layer consists of a simple columnar epithelium that is not ciliated and contains many protrusions resembling buds, giving it an irregular shape.

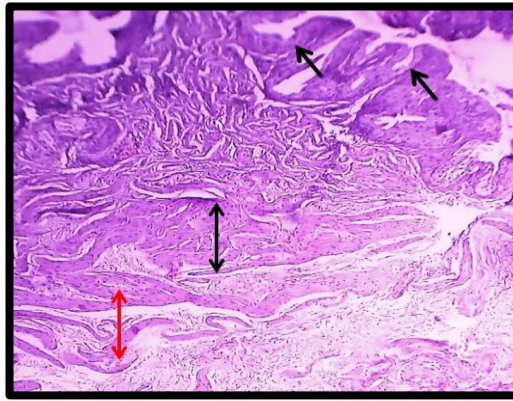


Figure 16: Section of vagina shows: (Black arrow) mucosal fold & (Black double head arrows) thick longitudinal smooth muscle (Red double head arrow) circular muscularis .H&E stain.40x.

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