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A Comparative Anatomical Study of the Female Reproductive System in Local Chickens at Different Ages (2, 4, and 6 Months)

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ABSTRACT

This study was conducted at the Animal House, College of Veterinary Medicine, University of Tikrit. A total of 45 laying hens were used and divided into three groups, each consisting of 15 hens at different ages (2 months, 4 months, and 6 months). The birds were raised under controlled conditions until they reached the target ages. Subsequently, the hens were humanely sacrificed, and the reproductive organs were collected, photographed, and examined to assess anatomical differences.

The study aimed to perform a comparative anatomical evaluation of the female reproductive system in laying hens at various developmental stages. The findings revealed distinct morphological changes, particularly in the ovaries and oviducts. At 6 months of age, significant development in ovarian structure and size was observed compared to the earlier ages (2 and 4 months), corresponding with the onset of sexual maturity and the hens' ability to produce eggs. Additionally, the oviduct showed notable elongation and differentiation of its segments at 6 months, reflecting its full functional development for egg formation and transport.

Introduction

The Anatomical Review

The Ovary

The ovary is located in the dorsal part of the abdominal cavity in the middle region of the body, adjacent to the left kidney. It is supplied with blood by the aortic artery and the caudal vena cava, which are located dorsally, and it is covered by the right and left adrenal glands [1]. In young hens, the ovary is located at the end of the lung and is close to the kidney. It exhibits follicular development during the early stages of life, giving the organ a granular appearance with a rough surface. In contrast, in mature hens, the ovary appears granular with many small follicles. In immature hens, the left ovary has a pyramidal shape with a pointed caudal end, pale pink to yellow in color, and a granular surface [2].

In mature hens, the left ovary during sexual activity shows a collection of nodules due to the presence of spherical follicles of varying sizes protruding from the ventral surface of the ovary. Each follicle is suspended and connected by a stalk or pedicle [1]. The mature ovary of a laying hen, which weighs about 20-30 grams, contains 4-6 follicles, each with a diameter of 2-4 cm. Before sexual maturity, the ovary weighs approximately 0.3-0.45 grams [3]

Oviduct

The oviduct of domestic poultry is clearly defined in sexually active birds as a coiled tube extending from one ovary to the uterus, occupying a larger part of the abdominal cavity [4]. At 8 weeks of age, differentiation appears between the funnel-shaped part with convoluted walls, the isthmus, and the thick-walled middle part, with the uterus resembling a thick-walled sac. The caudal part is the short muscular section, representing the vagina. The oviduct in the hen is a muscular, highly twisted tube responsible for transporting the egg from the ovary, fertilizing the egg, and depositing albumen, membranes, and the shell to form the final egg [5].

The oviduct is located in the dorsal region of the abdominal cavity, bordered dorsally by the left and often the right kidneys. On the left side, it is bounded by the body wall, while on the right side, it borders the intestines, spleen, and gizzard. The oviduct is separated from the dorsal wall by an air sac, and its right wall merges with the dorsal ligament of the oviduct, extending caudally [6].

In mature hens, the oviduct consists of five distinct regions: the infundibulum, magnum, isthmus, uterus, and vagina. The oviduct is attached to the dorsal wall of the abdominal cavity by a double layer of mesentery, dividing the oviduct into dorsal and ventral ligaments [5]. The weight of the oviduct in adult laying hens is about 75 grams, and its length is approximately 65 cm. In immature birds, the oviduct is significantly smaller, weighing around 5 grams and measuring 15 cm in length [7].

Infundibulum

The infundibulum is the first part of the oviduct in domestic poultry, divided into three functionally and morphologically distinct regions: the fimbrial region that directs and captures the ovulated egg, the infundibulum where sperm meets the egg for fertilization, and the calcareous region, referred to here as the distal infundibulum [8].

In laying hens, the infundibulum consists of a rough funnel followed by a tubular region. The total length of both regions ranges from 4 to 10 cm, with an average length of 7 cm. The infundibulum narrows to form a neck-like structure, with its walls thicker than those of the funnel and often thinner than other parts of the oviduct. Internally, the folds gradually lengthen in a gentle spiral, but they are more sensitive than those in the magnum. In mature hens at 6 months, the length of the infundibulum is 9.2±0.2 cm with a diameter of 7.8±0.4 cm. At 7 months, the infundibulum measures 9.7±0.8 cm in length and 8.2±0.2 cm in diameter [9].

Magnum

The magnum is the longest and most coiled part of the oviduct, and it is the largest section in laying hens, measuring about 34 cm in length. Its walls are much thicker than those of the infundibulum [10].

Isthmus

In laying hens, the isthmus is relatively short with a slightly reduced diameter. Its average length ranges from 4 to 12 cm, with a diameter of about 8 cm and 1 cm. The boundary between the isthmus and the magnum is sharply defined by a narrow band of tissue, approximately 1-3 cm wide (the transparent zone). The initial folds in this boundary area are relatively low, about 1.5 mm, and then gradually increase in height, though always narrower and shorter than those in the magnum. The number of primary folds in the isthmus ranges from 18 to 20. The mucosal color has been described as yellow-brown, darker than the rest of the oviduct, or white [11].

Uterus

The uterus is distinguished by a thicker wall than any other part of the oviduct and expands to form a sac-like structure [9]. The uterus contains two distinct regions: the tubular glandular region and the less distinctive sac-like cavity. The mucosal folds in the uterus of a mature laying hen are leaf-like and arranged transversely. These folds are longitudinal in shape, forming a leaf-like structure arranged in a circular pattern. The length of the uterus is about 7 cm and the width is 3 cm in laying hens [11].

Vagina

The vagina is the short distal part of the oviduct that opens into the cloaca. It has a well-developed muscular layer that forms a sphincter at the junction of the uterovaginal area. In adult laying hens, the vagina is a short S-shaped tube, while in other birds, like turkeys, it is a short tubular structure. In laying hens, the vagina contains fine mucosal folds arranged longitudinally, thinner and less prominent than in other regions of the oviduct [11].

Laboratory Work:

This experiment was conducted at the animal house of the College of Veterinary Medicine, Tikrit University, from December 12, 2023, to June 2, 2024, to study and compare the anatomical changes in the female reproductive system of laying hens at different ages (2, 4, and 6 months). The study was carried out on 50 laying hens provided by the poultry fields of the College of Agriculture, Tikrit University. These hens were housed at the animal house of the College of Veterinary Medicine, Tikrit University, from the age of 2 months until 6 months. The study involved four hens from each age group for the anatomical examination at each age stage. The hens were chosen randomly from the designated breeding hall according to the experimental design. After anesthetizing the hens with chloroform in strong doses, each bird was dissected immediately after anesthesia. Special blades were used for the dissection, starting from the abdominal opening to the end of the chest area. The entire female reproductive system was excised and then photographed for documentation

Results and Discussion:

The Ovary in Laying Hens at Different Ages

The results of the anatomical study of the left ovary in laying hens revealed that during the early months of life, the ovary maintains a similar structure, containing small, immature follicles. At 2 months of age, the ovary is undeveloped, measuring 2 ± 0.5 cm in length (as shown in Figure 1). At 4 months of age, the ovary begins to develop, with an increase in both length and weight, reaching 3 ± 0.4 cm (as shown in Figure 2).

At 6 months of age, following sexual maturity, the ovary becomes fully developed, and the follicles are distinctly visible with varying sizes. The mature follicles occupy the majority of the ovary due to their large numbers, as seen in Figure 3.

The anatomical study of the female reproductive system in laying hens, across all ages included in the study, confirmed that the left ovary is the functional ovary, while the right ovary is absent. This is consistent with the findings of [12], who studied the ovaries in chickens at different ages and reported that the ovaries in chickens develop asymmetrically, with only the left ovary fully developing.

Furthermore, the current study, through anatomical observation, revealed that the ovary in laying hens at all ages has a similar anatomical position to those found in other bird species. These findings align with Jamieson (2007), who described the ovary as located dorsally within the abdominal cavity at the mid-body level, with the ovary being firmly attached to the abdominal aorta by a membranous fold near the cranial end of the left kidney, in agreement with [13] in their study of the reproductive system in both male and female chickens.

Regarding differences in ovarian size between age groups, the study confirmed a noticeable difference in the ovarian size between 2-month-old and 4-month-old hens. The ovary at 4 months of age was larger, as indicated by the measurements provided in the results. Despite both age groups being sexually immature, this result aligns with [12] and [3], who studied the ovaries of chickens at different ages and noted differences in ovarian lengths.

At 6 months of age, the stage of sexual maturity, the study revealed a significant difference between the ovaries at 2 months and 4 months. At this age, the ovary contained mature follicles of larger size. In contrast, at 2 and 4 months, the ovary was inactive, containing only a few immature follicles. This result is consistent with [13], who studied the female reproductive system in breeding and non-breeding peafowl. They noted that during the active season, the left ovary contained three types of follicles: small, medium, and large, with the same follicle types found in non-breeding peafowl, albeit at a smaller size.

These findings are also consistent with [14], who studied the female reproductive system in Leghorn chickens and found that the left oviduct was much more complex in laying hens compared to non-laying hens, with its length being approximately double that in non-laying hens.

The Oviduct in Laying Hens

The anatomical results of the oviduct in laying hens at different ages (2, 4, and 6 months) showed that at 2 months, the oviduct appeared as a thin and narrow tube, with no clear distinction between its parts. The total length of the oviduct was 6.5 ± 1.5 cm (Figure 1). At 4 months, the oviduct began to elongate, reaching a length of 8 ± 1.5 cm, with the infundibulum area clearly visible near the ovary (Figure 2).

At 6 months, following ovarian maturation and egg production, there was a significant development in the oviduct, with an increase in both the length and the thickness of the walls. The infundibulum, the first part of the oviduct, measured 10 ± 2 cm and appeared semi-transparent, receiving the egg as it descended from the ovary (Figure 3). The magnum, the longest part of the oviduct, was white in color, with thicker walls than the infundibulum. It measured 25 ± 4 cm in laying hens at 6 months (Figure 3). The isthmus, located after the magnum and closer to the uterus, was shorter and had thinner walls compared to the magnum. It received the egg after the albumen was added in the magnum, measuring 8 ± 2 cm in length (Figure 3).

The current study confirmed that, at 2 and 4 months of age, the different parts of the oviduct (infundibulum, magnum, isthmus) could not be distinguished, as these age groups were sexually immature and incapable of egg production, despite being laying hens. This finding agrees with the study of [14], who confirmed that the oviduct could not be divided into distinct parts at 56 and 98 days of age. For this reason, the oviduct was divided into upper and lower sections based on their proximity to the ovary.

Regarding the oviduct at 6 months, the study showed a clear difference in size, with the oviduct of laying hens being significantly longer than that of hens at younger ages, as they had reached sexual maturity and were capable of egg production. In contrast, meat-type chickens remained sexually immature and their oviducts lacked distinct parts, confirming that the oviduct develops in hens that undergo sexual maturation. This result is consistent with [14], who studied the oviduct in the Rhea bird. The study also confirmed that the oviduct in mature laying hens is divided into three main sections (infundibulum, magnum, and isthmus), which agrees with [15], who studied the reproductive system of three species of birds.

The Uterus in Laying Hens

The anatomical results of the uterus in laying hens showed differences in size and development at different ages. At 2 months, the uterus was a small, undeveloped, light-colored sac-like structure, with a length of 2 ± 0.6 cm, making it difficult to distinguish (Figure 1). At 4 months, the uterus increased in size to 3.5 ± 0.5 cm, with some development in its shape and a slight increase in its width (Figure 2). At 6 months, following sexual maturity, the uterus became fully developed, increasing in length and width, with a length of 5.5 ± 4 cm and a width of 6 ± 1 cm. The uterine folds were clearly visible in the inner layers of the uterus (Figure 3). Figure 3 also shows an egg in the uterine region, where it receives the calcium shell from the uterus (shell gland). Figure 4 illustrates the uterine structure at 6 months, which contains soft tissues with internal soft folds.

The current study observed that the uterus, which is the shell gland responsible for adding the hard calcium shell to the egg, was undeveloped and its structure was not clear at 2 and 4 months of age in the hens studied, as these were sexually immature and incapable of egg production. This finding aligns with [12]. However, the study showed that the uterus at 4 months was longer than at 2 months, as laying hens exhibit faster sexual development. This result is consistent with [15].

At 6 months, the study confirmed that the uterus in mature laying hens was fully developed and specialized for egg shell production, as it was capable of producing a complete egg at this age. This result is consistent with many studies on the female reproductive systems in various birds, including domestic chickens [15], turkeys [16], and geese [17].

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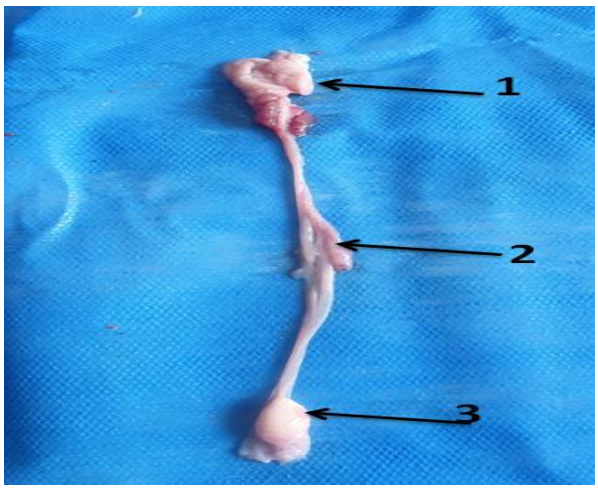

Figure (1): shows the female reproductive system in laying hens at the age of 2 months, ovary (1), oviduct (2), uterus (3).

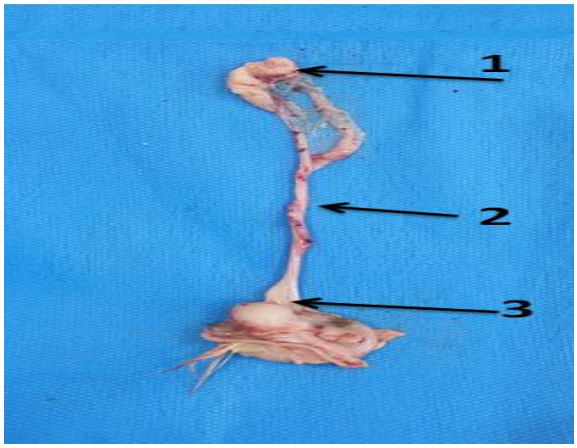

Figure (2) Shows the female reproductive system of laying hens at 4 months of age. The ovary (1), oviduct (2), and uterus (3)

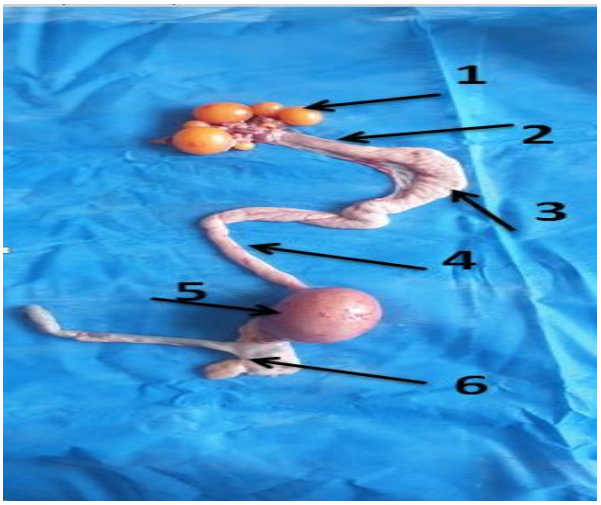

Figure (3): Shows the female reproductive system of laying hens at 6 months of age, showing the egg in the uterus region of the oviduct. The ovary (1), infundibulum (2), magnum (3), isthmus (4), uterus (5), and cloaca (6).

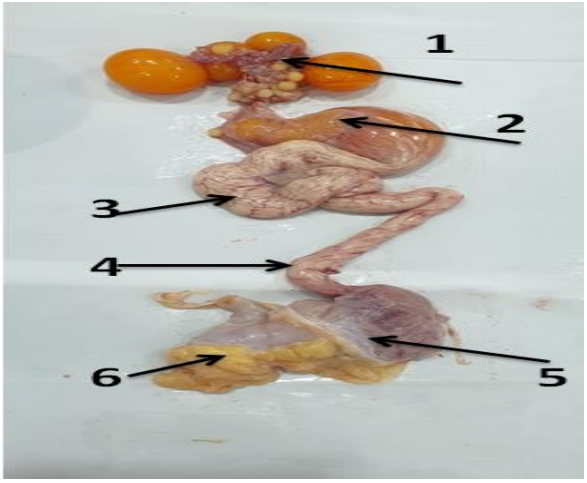

Figure (4): shows the female reproductive system in laying hens at the age of 6 months (the presence of the egg in the infundibulum of the oviduct), ovary (1), infundibulum (2), oviduct (3)), isthmus (4), uterus (5), exit (6).

Conclusions

This study revealed clear morphological differences in the female reproductive system of local laying hens at 2, 4, and 6 months of age. The ovary showed progressive development, with small, immature follicles at 2 months and large, mature, yellow follicles at 6 months, indicating sexual maturity. Similarly, the oviduct was underdeveloped and undifferentiated at 2 and 4 months, while at 6 months it became fully developed with distinct segments (infundibulum, magnum, and isthmus), capable of performing its reproductive function.

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دراسة تشريحية مقارنة للجهاز التناسلي الانثوي في الدجاج المحلي بأعمار مختلفة (2 ،4 و 6 اشهر)

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الملخص

أُجريت الدراسة في البيت الحيواني في كلية الطب البيطري / جامعة تكريت وشملت الدراسة (45) من الدجاج البياض التي وزعت الى ثلاثة مجاميع كل مجموعة احتوت على (15) من الدجاج البياض في اعمار مختلفة وتم تربيتها لحين الوصول الى العمر المطلوب في الدراسة (2 شهر، 4 اشهر، 6 اشهر) وبعدها تم التضحية بالحيوانات واخذ الأعضاء المطلوبة بالدراسة وتم تصويرها ودراسة الفروقات الحاصلة بينها.

أذ تناولت هذه الدراسة مقارنة تشريحية للجهاز التناسلي الانثوي للدجاج البياض وبأعمار مختلفة، واظهرت النتائج تغيرات مظهرية في الجهاز التناسلي للدجاج حيث حدث تطور في شكل وحجم المبيض في عمر 6 اشهر بالمقارنة مع عمر 2 شهر و4 اشهر كون عمر 6 اشهر في الدجاج اصبح ناضجاً جنسياً وله القدرة على انتاج البيض ، كذلك حصل تطور في شكل وطول قناة المبيض في كل اجزاءها في عمر 6 اشهر بالمقارنة في عمر 2 شهر و4 اشهر وذلك كون قناة البيض اصبحت متخصصة في القيام بوظيفتها الحيوية في انتاج البيض في كل قسم من اقسام قناة.

الكلمات المفتاحية: الدجاج المحلي، الجهاز التناسلي الانثوي، المبيض، قناة البيض، الرحم.