

Morphology and Morphometric Study of Left and Right Harderian Glands in Duck and Broiler

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Received: 2024, 15, Apr

Accepted: 2025, 21, May

Published: 2025, 21, Jun

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Annotation: The aim of study is to determine the comparative morphological morphometric features of harderian gland of two species of birds, the birds were broiler chicken and, duck were taken (10 birds for each species) the birds scarified then the dissected and removed the gland that grossly examined and morphometric measurement (length and width) of gland were done. The study noticed the color of chicken glands were light brown to pink and they are different in size and shape in each other. in was elongated and small, the smaller one was in duck its teardrop in shape.

Keywords: morphology, morphometric, duck, broiler.

Introduction

In fowl and in turkey respectively, that the harderian glands were relatively large and had been much developed than the lacrimal gland. The latter author added that the harderian gland was the lymph epithelial organ. **(1)**

The harderian gland forms a unitary structure which is firmly attached to the medial part of the orbit and whose duct normally opens on the surface of the nictitating membrane.

This distinguishes the harderian gland (otherwise known as the glandula palpebra tertia profundus/deep gland of the nictitating membrane) from both the lateral ocular or lacrimal glands, and the other medial ocular gland, the gland of the nictitating membrane (glandula palpebra tertia superficialis/superficial gland of the nictitating membrane), typified by clusters of glandular tissue actually within the nictitating membrane.

The harderian gland is often surprisingly large, in some cases larger than the eye itself. **(2)** The gland occurs in all groups of terrestrial vertebrates, the anuran amphibia, reptiles, birds and mammals. It has not been described in fish or the aquatic urodele amphibia (nor in the larval forms of anurans), but it is present in secondarily aquatic forms such as crocodiles and cetaceans.

It is said to be absent in some types of mammals, notably bats, cows and horses, terrestrial carnivores and higher primates. (3)

The functions attributed to the gland are many and diverse. Amongst these, it has been held to be a site of immune responses, a source of thermoregulatory lipids, a source of pheromones, a photoprotective organ and part of a retinal-pineal axis. (4)

It is arguably the last remaining large organ of widespread distribution among the vertebrates to which we cannot confidently ascribe a confirmed function.

Materials and Methods

Twenty apparently healthy broiler and duck birds were divided into two equal groups, The first subgroup of each species used for anatomical study, while the second group was used for histological, histochemical, and ultra structural studies. These birds were purchased from the local suppliers in common markets in aldwynia province from September to March at 2024-2025.

Morphological study All studied birds were weighed, then euthanized by inhalation by chlorophorm (5). Each bird was dissected by fixing it on a suitable dissecting board to view the eye including the left and right harderian glands in two species . A mid-line incision in the skull wall was made, after that, the left and right HD were identified and photographed in situ using a digital camera (Sony Dsc-H90). The location and relationships of each part . samples were extirpated and washed with normal saline to remove adhered debris and blood, then the cleaned again by normal saline. Then, the weights of studied organs were measured in grams by using a sensitive digital scale (Notebook series-Digital scale). The macroscopic measurements (length, thickness and diameters) of the collected segments were conducted in centimeter and millimeters by using the electronic Vernier caliper.

Result

Morphological finding of Harderian glands in broiler chickens

The Harder's gland is located on the ventro-medial side of the eye socket (orbit), between the eyeball and the frontal bone, specifically in the medial wall of the eye socket, within soft fatty tissue and surrounded by a thin sheath of connective tissue. (Fig1,2)

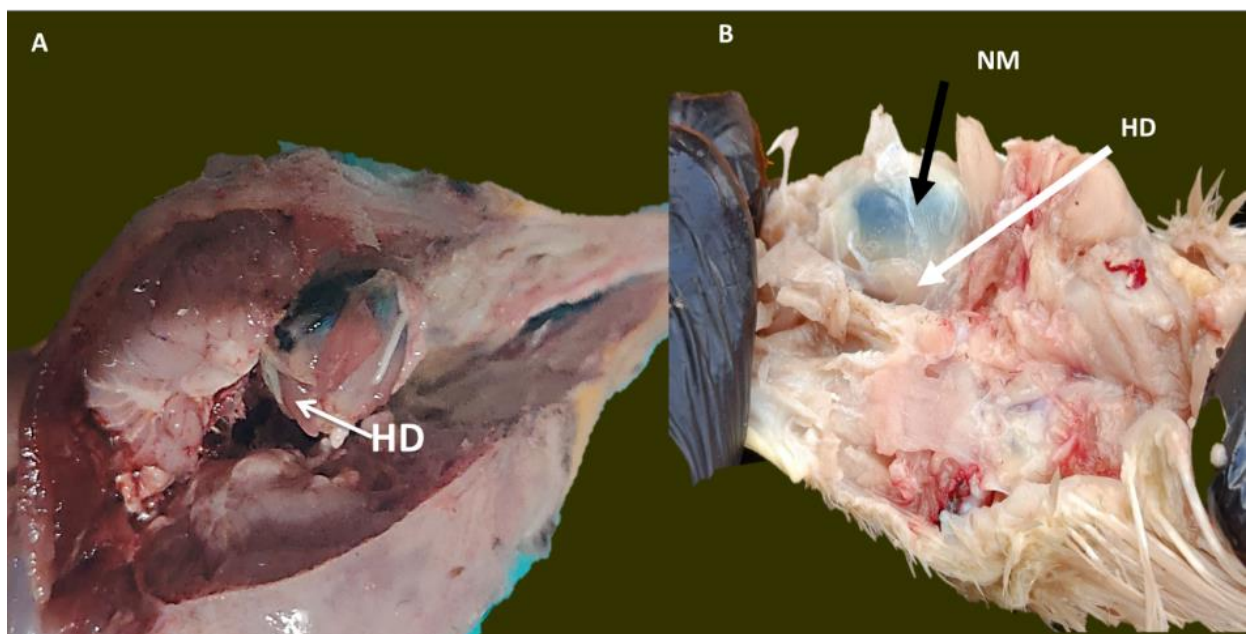


Fig. 1: A&B: photomicrograph of right Harderian gland (HD) in broiler ventromedial back to the orbit and smooth surface of these glands duct of HD connect with nictitating membrane(NM).

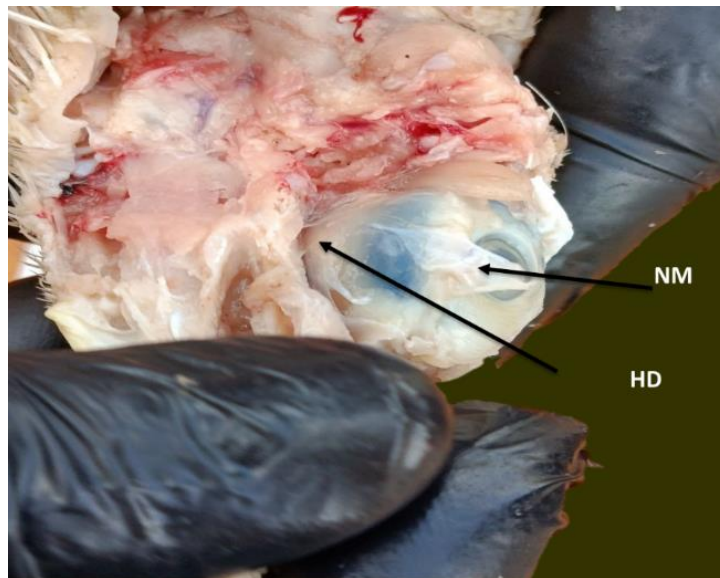


Fig. 2: photomicrograph of right Harderian gland (RHD) in broiler ventromedial back to the orbit and smooth surface of these glands. Connect with nictitating membrane (NM)

Color and Size of the gland was pale pink to yellowish white in color and was more prominent in the left eye than in the right eye in terms of size and length. Shape the gland is elongated oval in shape, slightly curved posteriorly and inferiorly. It tends to be relatively flat, and is generally more elongated on the left side than the right, showing incomplete symmetry between the two sides. (Fig3), Lateral differences, the left Harderian gland was clearly larger in size, length, and width than the right gland in most specimens, indicating incomplete symmetry between the two sides.

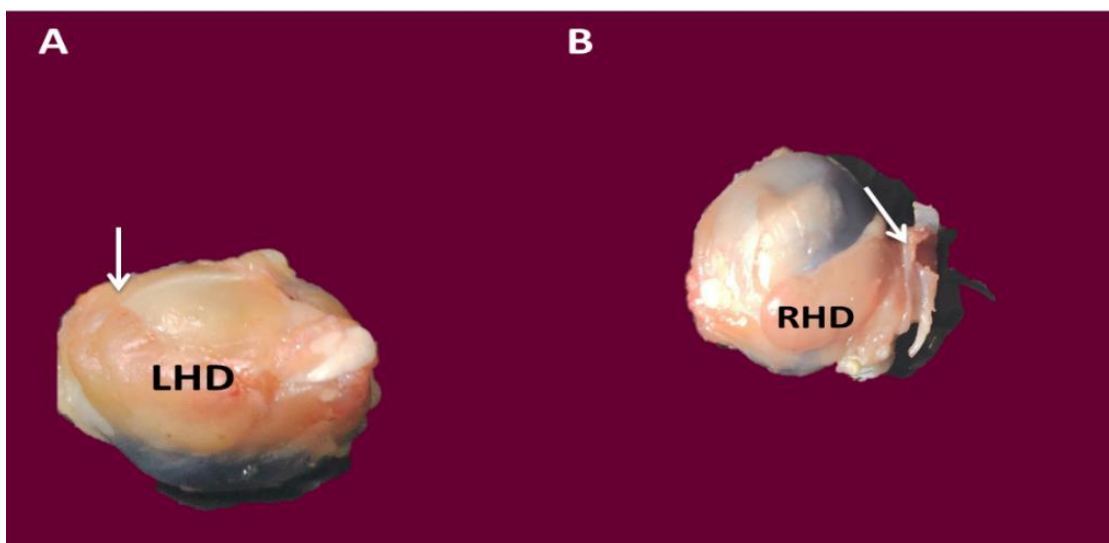


Fig. 3 A&B: photomicrograph of left Harderian gland (RHD) in broiler ventromedial back to the orbit between muscle of the eye. Left high in length and weight than right

The study revealed that the Harder's gland in broiler chickens has an elongated, rectangular shape upon gross examination, extending along the medial wall of the eye socket. Three main excretory ducts were observed, short and thin, two of which directed towards the nasal cavity, while the third directed towards the nictitating membrane (the transparent third eyelid), into which it drains directly. This ductal organization suggests a dual role for the gland: both lubricating the eye through its secretions towards the nictitating membrane, and contributing to the immune defense of the upper respiratory tract by draining secretory components into the nasal cavity. In broiler chickens the Harderian gland duct has been observed to be relatively short and thin, extending directly from the gland toward the medial angle of the eye (Fig. 4).



Fig. 4: photomicrograph of left Harderian gland in broiler show duct of gland (black arrow) connect with the nicking membrane (blue arrow).

Morphological finding of Harderian glands in ducks:

The Harder's gland is located on the medial wall of the eye socket, between the eyeball and the surrounding orbital bones, specifically near the medial angle of the eye. It is immersed in relatively dense connective tissue compared to that of chickens. (Fig.5), Lateral differences; As in chickens, the left hardening gland in ducks was larger than the right, with a more pronounced difference in length and weight, indicating a consistent pattern of volumetric superiority of the left gland.

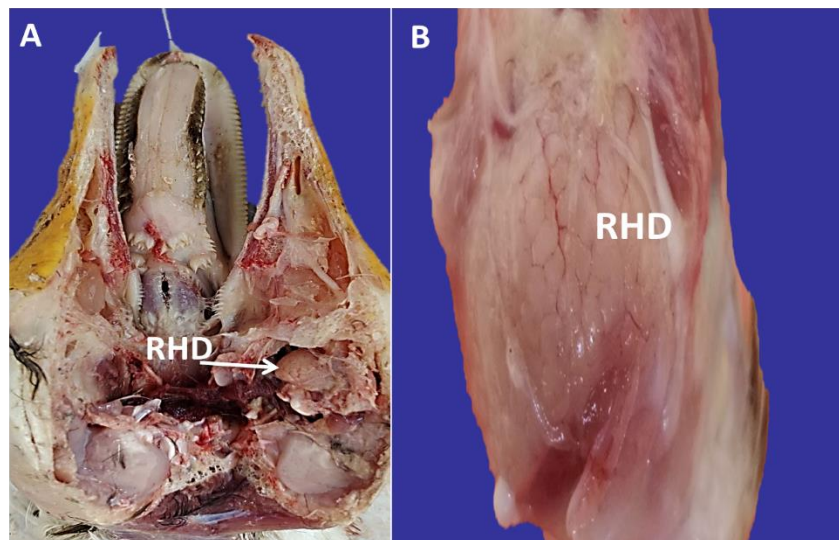


Fig. 5 A&B: photomicrograph of right Harderian gland (RHD) in Duck ventromedial back to the orbit and lobulated glands.

Shape and color of the gland is characterized by an elongated, oval, or spindle-shaped, and tends to be fuller and more prominent than its counterpart in broiler chickens. It also appears more swollen and has clear borders. The left gland is often larger and more elongated than the right, with a slight posterior-medial slope, The gland was dark pink or reddish in color and was more voluminous than in broiler chickens, possibly reflecting a difference in secretory content or immune function between the two species. (Fig.6, 7 &8).

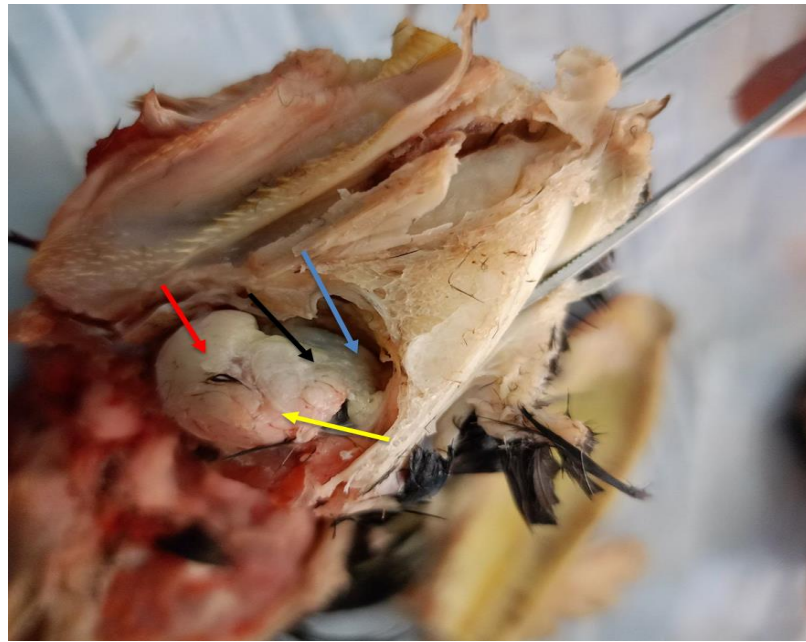


Fig. 6: photomicrograph of left Harderian gland (LHD) in Duck showed pale pink in colour, hemispherical and arrow shaped with a small dorsal lobe (red arrow) and a large ventral lobe (yellow arrow). From its rostral aspect, at the angle formed by both the lobes, emerged a duct (black arrow), and opened into the conjunctival sac at the base of the nictitating membrane (blue arrow)



Fig.7; A,B,&C: The surface of the harderian gland before and after remove from orbital cavity was convex (green arrow) and that facing the eyeball was concave (black arrow)

A single, distinct main excretory duct was observed, originating from the medial portion of the gland and directed at an oblique angle toward the nictitating membrane (third eyelid), into which it drains directly. The study did not record the presence of additional, distinct ducts directed toward the nasal cavity, as in chickens. This anatomical pattern suggests that the gland in ducks plays a key functional role in hydrating and protecting the eye, especially in aquatic environments, through its secretions directed primarily to the surface of the eye via the third eyelid, enhancing its defensive and protective function (Fig.8).

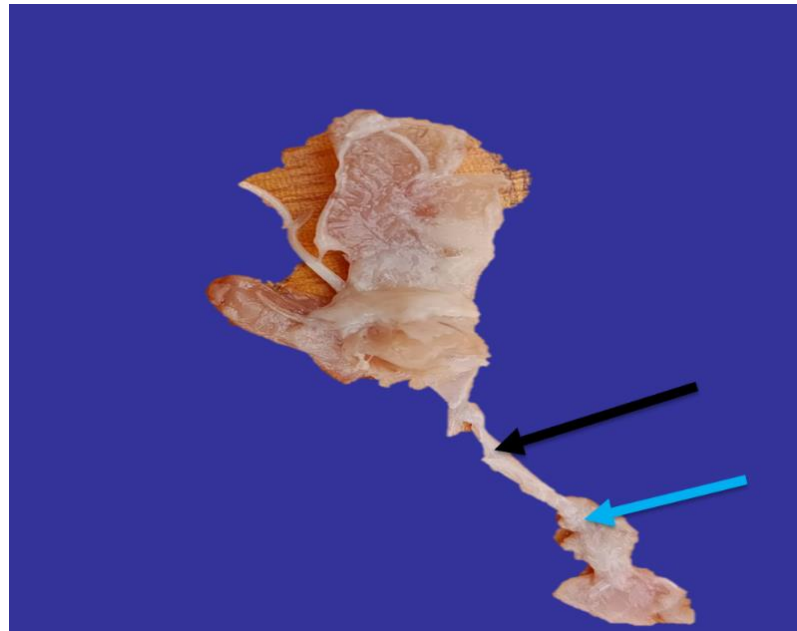


Fig.8: photomicrograph of left Harderian gland in duck show duct of gland (black arrow) connect with the nicking membrane (blue arrow).

Morphometric finding of Harderian glands in Broiler & ducks:

The length of left and right hardian glands in Broiler & ducks morphometric measurement were 0.370 ± 0.01 Ab 0.446 ± 0.04 Aa 0.733 ± 0.12 Ba 0.871 ± 0.16 Ba as follows where the weight of glands left and right in broiler and duck were 0.914 ± 0.15 Aa 0.793 ± 0.14 Aa 0.828 ± 0.12 Aa 0.765 ± 0.12 Aa gm as follows , while the width in left and right harderian glands in broiler and duck 0.422 ± 0.01 Aa 0.216 ± 0.01 Aa 1.18 ± 0.17 Bb 0.825 ± 0.11 Ba cm as follows there are significates difference high in left than in right in rooster and dove (table 1)

Table .1 the mean and standard error of the morphological measurement of the harderian glands in broiler chicken and duck

	Broiler		duck		LSD value
	left	right	left	right	
Length (cm)	0.370 ± 0.01 Ab	0.446 ± 0.04 Aa	0.733 ± 0.12 Ba	0.871 ± 0.16 Ba	0.309
Weight of glands(gm)	0.914 ± 0.15 Aa	0.793 ± 0.14 Aa	0.828 ± 0.12 Aa	0.765 ± 0.12 Aa	0.388
Weight of birds(gm)	2.09 ± 0.08 A- 2092.04 ± 87.3 A		1.49 ± 0.02 B- 1490 ± 23.2 B		181
Relative weight	0.047 ± 0.008 Ab	0.036 ± 0.007 Aa	0.054 ± 0.009 Aa	0.048 ± 0.008 Ba	0.009
Width(cm)	0.422 ± 0.01 Aa	0.216 ± 0.01 Aa	1.18 ± 0.17 Bb	0.825 ± 0.11 Ba	0.292
Thickness(mm)	0.850 ± 0.14 Aa	0.793 ± 0.12 Aa	0.983 ± 0.12 Aa	0.963 ± 0.13 Aa	0.362

Discussion

Discussion of the morphological Findings of Harderian glands in broiler chickens:

The Harder's gland is an important orbital gland associated with the ocular and peripheral immune systems in birds. In broiler chickens, this gland occupies a specific location on the ventromedial side of the orbit, located between the eyeball and the frontal bone. It is immersed in soft fatty tissue and surrounded by a thin sheath of fibrous connective tissue. This anatomical location is consistent with several previous anatomical studies on domestic birds, which

demonstrated a distinct pattern of positioning and location in the medial wall of the orbit, reinforcing the gland's role in direct contact with immune and lacrimal components related to the ocular and nasal systems. (6) Morphologically, the morphological appearance of the gland in broiler chickens is elongated and rectangular, consistent with the anatomical characteristics of terrestrial birds with advanced vision. The gland secretes immune components (particularly plasma cells and lymphocytes) and lipid compounds to the surface of the eye and nasal cavity (7). Its central location in this region supports its role in producing mucous and lipid secretions that contribute to the protection of the cornea and third eyelid.

The gland is surrounded by a thin connective tissue sheath, which has functional importance in supporting its structural composition and ensuring the passage of small blood and lymphatic vessels. (8) in their anatomical description of Harder's gland in poultry. They asserted that the gland's position amidst the fatty tissue allows it to be flexible and move slightly with eye movement without affecting its secretion. These anatomical features demonstrate that the Harderian gland in broiler chickens plays a dual role, both immunological and anatomical, providing protection to the ocular surface and participating in the local immune response via the blinking membrane and nasal cavity. This anatomical adaptation supports high visual and immunological efficiency in poultry, especially in intensive rearing environments where the need for protection from environmental and pathological factors is high.

Our observations indicate that the color of the Harderian gland in broiler chickens ranges from pale pink to yellowish-white, consistent with what (5), who described the gland as located on the ventral side of the eye and characterized by a light color and a narrow center in some specimens. This light color reflects the distinctive secretory composition of the Harderian gland, which contains a mixture of ocular, lipid, and immune components, enhancing its ability to support immune hydration of the ocular surface and third eyelid, as recent studies have demonstrated. Regarding its morphology, our results revealed that the gland is elongated, slightly curved posteriorly and downward, and relatively flat. Recent microanatomical studies have supported this observation, with (9) demonstrating that the Harderian gland in Haysex Brown chickens is a multi-lobed, tubulo-lobular claw gland, containing parallel secretory lobules, and enclosed in a thin connective capsule with septal emanations. This anatomical structure provides spatial flexibility within the orbit and explains the observed curvature that allows the gland to align with the structure of the eyeball.

What caught our attention most was the clear lateral asymmetry favoring the left gland, which was larger in length and width than the right gland in most specimens. This is consistent with reports of a natural asymmetry between the sides of the gland in birds, as observed in studies of the Harderian gland in Fayoumi and Leghorn chickens (frontiersin.org), and similar to what (10) found regarding the asymmetry in secretory activities between the two sides. This lateral asymmetry is thought to be related to differences in blood supply, neurogenesis, or the degree of greater use of one eye than the other, which enhances the enrichment of immune and secretory activity on one side versus the other.

In addition, recent studies have also indicated that the Harderian gland interacts dynamically with immune and vaccine factors; (9) Expansion of lymphoid tissue within the glands after birds receive multiple vaccinations, especially after 50 days of age. Combining these data with the current findings suggests that the enlargement of the left gland may be a result of a difference in immune activity or exposure to differences in immune input between the eyes.

The results of the recent study revealed that the Harder's gland in broiler chickens takes an elongated, rectangular shape, extending along the medial wall of the eye socket. This is consistent with (11) the descriptive characteristics of the gland in ground chickens, such as the Kadaknath breed, where the gland is documented to be positioned suborbitally within a thin connective sheath.

Three main excretory ducts were observed, both thin and short, two of which lead to the nasal

cavity, while the third leads directly to the nictitating membrane (the transparent third eyelid), into which it empties. This arrangement is consistent with the immunophysiological features of the nasolacrimal duct anatomy, as it was found to empty into the Choanae openings in three-dimensional studies of chickens According to (12) This a gland that performs dual functions: first, it secretes lubricating substances for the eye and third eyelid, and second, it secretes defensive components that are discharged to the upper respiratory tract via the nasal ducts, enhancing local immunity. This is consistent with research findings on the role of the gland in enhancing mucosal immunity when chickens are vaccinated against influenza using ocular instillation techniques (5). Furthermore, the Harderian duct was found to be short and thin, extending directly from the gland to the medial angle of the eye, reflecting an efficient ductal structure that discharges its secretions directly without labyrinths or large branches. This finding is supported by careful anatomical studies demonstrating the course of the gland's ducts within the orbit(13)

Discussion of the morphological finding of Harderian glands in ducks:

The results of the study demonstrate that the Harder's gland in ducks is clearly located on the medial wall of the eye socket (orbit), directly aligned between the eyeball and the septal bones, and clearly near the medial angle of the eye. This duct protrudes within dense connective tissue, indicating the gland's anchorage within the orbit. This indicates its structural importance in maintaining the gland's stability during eye movement and surrounding muscle activity, Macroscopically, studies such as (14) in domestic ducks have shown that the gland is encased within a dense connective capsule. Blood vessels and nerves are found within the septa of this layer, enhancing the gland's secretory capacity and neural regulation(5)

Size differences between the two sides: In this study, the left gland in ducks was significantly larger in length and weight than the right. Although several studies such as (15) have reported some differences, these have not reached the level of significance. However, our results show a documented pattern that is repeated in many samples, suggesting a consistent pattern of anatomical asymmetry, which may have physiological backgrounds related to the left hemisphere of the nervous system or lateral blood distribution.

The study showed that the Harder's gland in ducks exhibits more pronounced and active morphological features than those in broiler chickens, the Shape, size, and dimensions: The gland often appears oblong, oval, or spindle-shaped, and tends to be fuller and more prominent than its counterpart in broiler chickens, with clearly defined borders, Innovative studies (16)

(such as geese) confirm that the gland extends clearly into the orbit and is larger than in chickens, with the average gland length in ducks being approximately 1.65 cm compared to approximately 0.7 cm in penguins and other species.

Color and tissue density of the gland color was observed to be dark pink or reddish, with a significantly higher tissue density, reflecting increased secretory content and possibly greater immune activity compared to broiler chickens. (17) the light pink color was found in ducks, but a greater color saturation was observed in native chickens, (18) study also noted a more intense color. The gland was shown to be enclosed within a dense connective capsule with blood vessels and nerves, which explains the dark color and relative density of the surrounding tissue , Lateral asymmetry between the two glands: As in broiler chickens, the left Harder's gland was found to be superior to the right in length and weight (up to 1.65 cm in length versus a wider diameter and more fleshy tissue).The results support similar trends observed in hybrid and Lebanese duck breeds, although some studies (17) were not statistically significant. However, the lateral asymmetry is consistent with previous studies that have shown imperfect symmetry in birds, attributed to the distribution of blood vessels or local neural differences.

The study's observations revealed that the Harder's gland in ducks possesses a single, distinct main excretory duct, which runs from the middle of the gland toward the nictitating membrane

(the transparent third eyelid) at an oblique angle, emptying its secretions directly into it. Additional ducts directed toward the nose, as in broiler chickens, were not recorded, indicating a difference in anatomical organization between the two species. Recent literature suggests that ducks, as aquatic birds, have adapted their gland structure to suit their unique environmental needs. For example, a single excretory duct ensures that secretions are concentrated only on the eye, supporting corneal hydration and protecting it from desiccation and environmental pollution. (19) observed that the gland duct in ducks is short and direct, opening at the base of the nictitating membrane, enabling continuous, uninterrupted secretion (19). Functional implications: This sharp, targeted organization supports the gland's specific, individual role in effectively moisturizing and protecting the eye, which is critical for waterfowl exposed to constantly humid and wet environments. Concentrating on a single duct also reduces the loss and dispersion of secretions and improves the distribution of the oily smear across the corneal and eyelid surfaces.

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