Original Article

A Periodic Comparison of Harderian Gland in Henna Partridge (*Alectoris chukar*) According to Different Developmental Stages

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How to Cite This Article Yaren Kuloğlu, H., & Boydak, M. (2024). A Periodic Comparison of Harderian Gland in Henna Partridge (Alectoris chukar) According to Different Developmental Stages. *Iranian Journal of Veterinary Medicine, 18*(3), 359-376. http://dx.doi.org/10.32598/ijvm.18.3.1005521

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ABSTRACT

Background: The present study aimed at determining histological structure and histochemical properties of the henna partridge (*Alectoris chukar*) Harderian gland periodically.

Objectives: For this purpose, the Harderian glands of 12 (6 females + 6 males) healthy henna partridges aged 3 and 6 months were used.

Methods: Totally removed Harderian gland tissue samples were kept in 10% neutral formolin for 36 hours and fixed. After washing, dehydrating, and polishing with known histological techniques, tissue pieces were blocked in paraffin.

Results: We found that a thin connective tissue capsule surrounds the Harderian gland of the henna partridge and that the capsule sends septums into the gland and divides the gland into lobes and lobules. It was observed that the corpus glandulae consist of low or high prismatic epithelial cells. Within each lobe, there is a single main draining channel which has a very large lumen along with primary draining channels. Primary and main draining channel epithelial cells have a single-layered cuboidal structure. By Gordon-Sweet staining, it was found that reticular fiber bundles started from the connective tissue capsule that surrounded the organ and spread by branching. The reticular fiber bundles extended in thin strands to the periphery of the corpus glandulae. These reticular fiber bundles in the regions where the connective tissue septums widened are thicker and form a network. The reticular fiber bundles are seen in the basal part of the epithelial cells forming the main draining channel and especially in the crypt areas. Reticular fibers are also found around blood vessels. Strong Alcian blue (AB)-positive epithelial cells are observed in the corpus glandulae in AB pH=2.5 staining, but no periodic acid-Schiff (PAS)-positive epithelial cells are observed in PAS staining. While the majority of primary draining channel cells show a strong AB-positive reaction, a few cells showed a weak PAS-positive reaction. Regarding the main draining channel epithelium, goblet cells show a weak and strong AB-positive reaction in AB pH=2.5 staining method, respectively and a weak PAS-positive reaction in PAS staining method.

Conclusion: In line with these findings, no significant difference was found in terms of general histological structure and histochemical properties of the 3- and 6-month-old henna partridge Harderian gland.

Keywords: *Alectoris chukar*, Alcian Blue, Harderian gland, Histology, Periodic acid-Schiff

Article info:
Received: 6 Mar 2024
Accepted: 7 May 2024
Publish: 01 Jul 2024

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Introduction

Palpebra tertia (PT=plica semilunaris conjunctiva, membrana nictitans), in the medial eye angle, is a conjunctival fold which is supported by cartilago palpebra tertia (CPT), which is a cartilago shaped like the letter "T" and characterized by hyaline or elastic cartilago tissue. PT in animals replaces the conjunctiva washing mechanism that exists in humans, running from the lower and upper eyelids directly towards the nasal cavity (ductus nasolacrimalis) (Kuloğlu, 2016; Kuloğlu & Boydak, 2023).

Birds, reptiles, frogs, and mammals have this gland. It is also fully developed in pigs and rodents. However, it is rudimentary in monkeys, while fish, aquatic amphibians, bats, terrestrial carnivores and primates lack it (Rehorek & Smith, 2006). The composition of Harderian gland secretion varies greatly among vertebrate classes. This secretion is serous or sero-mucous in reptiles (Chieffi et al.,1992a), mucous in birds (Payne, 1994), and lipid in mammals (Olcese & Wesche 1989; Sakai & Yohro, 1981; Kaya & Kuloğlu, 2022). Harderian gland is responsible for cleaning the cornea and lubricating the nictitans membrane. In addition, the gland is a source of salt in pheromones and some turtles, provides osmoregulation and thermoregulation in some rodents, has receptors for gonadal hormones, such as estrogen and testosterone in hamsters and plays a role in sexual differentiation (Chieffi et al., 1992b; Brobby, 1972; Burns & Maxwell, 1979; Kozlu et al., 2010; Rehorek & Smith, 2006; Yaghoubi et al., 2019; Santillo et al., 2020). In poultry, the most important feature of Harderian gland is the existence of plasma cells originating from the bursa Fabricius. These plasma cells can synthesize IgA and Ig G (Russel & Koch, 1989) class immunoglobulins.

A lot of studies on different bird species Harderian gland are found in the literature (Altunay & Kozlu, 2004; Dimitrov & Nikiforov, 2005; Kozlu & Altunay, 2011; Önal & Çınar, 2013). However, there was no study regarding the periodic development of the henna partridge (*Alectoris chukar*) Harderian gland. In this study, we aimed at determining the histological structure and histochemical properties of the henna partridge Harderian gland periodically.

Materials and Methods

Study animals

Harderian glands of twelve 3-month-old (6 males, 6 females) and twelve 6-month-old (6 males, 6 females) henna partridges used in this study were bought from a private farm (Türkiye/Antalya). The animals were kept in natural light, temperature, and humidity levels and had unrestricted access to food and water.

Histology and histochemistry

The totally removed Harderian gland tissue samples were kept in 10% neutral formolin for 36 hours and fixed. After washing, dehydrating, and polishing with known histological techniques, tissue pieces were blocked in paraffin. The 5-µm thick sections taken from the blocks were subjected to the procedures below.

1- Triple staining technique of Mallory (Mallory, 1900) which was modified by Crosman for use in general histological analysis.

2- To examine the quality of the secretion material in the gland tissue;

Periodic acid-Schiff (PAS) (McManus 1946) method to demonstrate neutral mucosubstance.

Alcian blue (AB) pH=2.5 (Scott & Dorling 1965) method to demonstrate acidic mucosubstance.

PAS/AB pH=2.5 combined staining method to demonstrate both neutral and acidic mucosubstance (Mowry 1956).

3- Gordon-Sweet (GS) staining method to demonstrate reticular fibers (Lillie, 1965).

The preparations were analysed under the light microscope (Leica DM2500, Switzerland). With the same microscope's Leica DFC 320 (Switzerland) camera attachment, the shapes of the regions considered necessary were taken.

Results

The naked eye examination revealed that the henna partridge Harderian gland was located at the continuation of the palpebra tertia in the medial eye angle (Figure 1) and was connected to this organ. The Harderian gland of the henna partridge was found to be dirty yellow in color, resembling an irregular half-moon shape (Figure

Figure 1. Localization of the Harderian gland in the *A. chukar*

2), which conformed to the bulbus oculi's shape, and had a smooth surface. It was observed that Harderian gland had no relationship with cartilago palpebra tertia. A thin connective tissue capsule sends septums into the gland surrounding Harderian glands of henna partridges. The gland was divided into lobes by the connective tissue partitions and the lobes were divided into small lobules by thinner connective tissue septums separated from the interlobar septums (Figure 3). One of these lobules was separated from the others by a thinner connective tissue septum. Medium-sized blood vessels were observed at the corners where the lobules contacted each other (Figure 4). Also, there were corpus glandulae in compound tubuloalveolar structure within the lobes. These corpus glandulae comprised low or high prismatic shaped cells. On the epithelial cells' basal surfaces, nuclei of myoepithelial cells were visible (Figure 5). A single main draining channel with an eccentrically located lumen and an irregular shape was observed between the lobes of the Harderian gland of henna partridge (Figure 6). The epithelial cells surrounding the main draining channel in the Harderian gland were observed to be cuboidal-shaped and single-layered (Figure 7). In addition, the inner surface of the primary draining channel was surrounded by

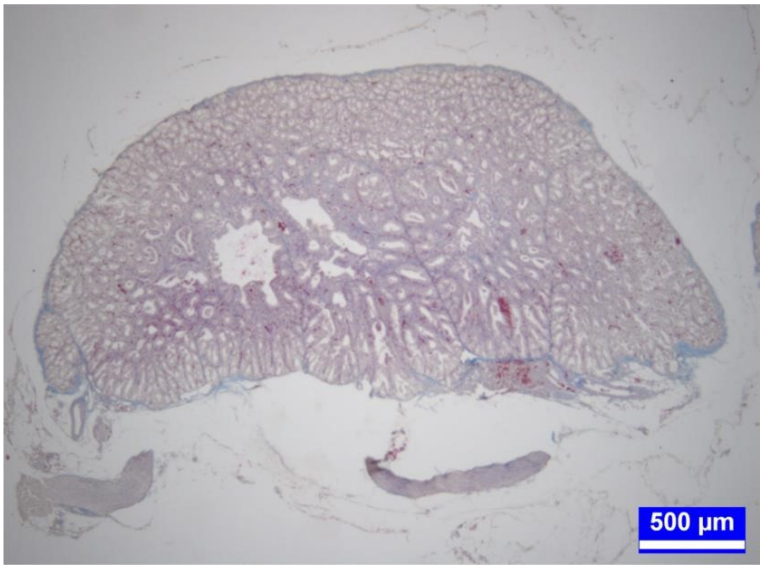

Figure 2. General view of the Harderian gland in a 3-month-old *A. chukar*

Note: Half-moon-shaped image of the organ (triple staining).

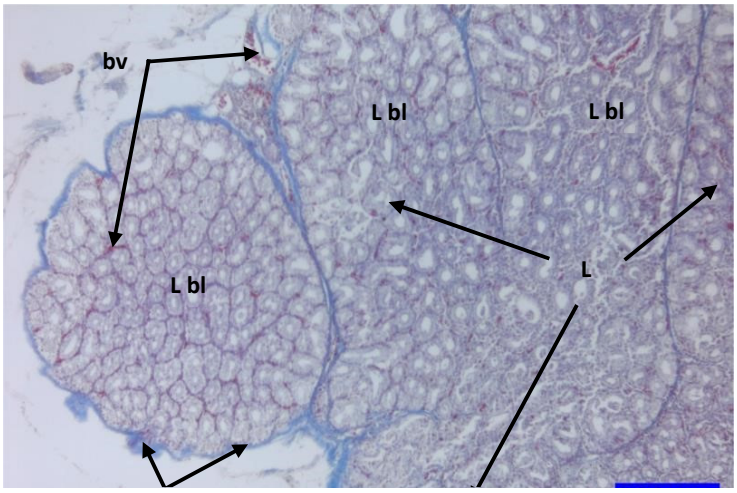

Figure 3. Thin connective tissue capsule (cts) surrounding the Harderian gland of a 6-month-old Henna partridge (*A. chukar*)

Abbreviations: L: Lobe; Lbl: Lobules; Bv: Blood vessels.

Note: Lobe and lobules are noticeable (triple staining).

serous and single-layered cuboidal epithelium, arranged regularly around the lumen of the duct, and that the cell borders were distinct (Figures 8 and 9).

In GS staining, reticular fiber bundles were observed to start from the connective tissue capsule that surrounds the organ and spread by branching (Figures 10 and 11). The reticular fiber bundles extended in thin arms to the periphery of the corpus glandulae. In the regions where the connective tissue septum expanded, the reticular fiber bundles were thicker and formed a network (Figure 12). The reticular fiber bundles were seen in the basal part of the epithelial cells forming the main draining channel and especially in the crypt areas. The reticular fibers were also observed around the blood vessels (Figure 13).

Histochemical results

In the staining performed with AB at pH=2.5, it was noted that the epithelial cells forming corpus glandulae of the Harderian gland showed a strong AB-positive reaction (Figures 14 and 15). AB-positive cells were found in the primary (Figure 16) and main draining channel (Figure 17) epithelial cells of the Harderian gland in the henna partridge.

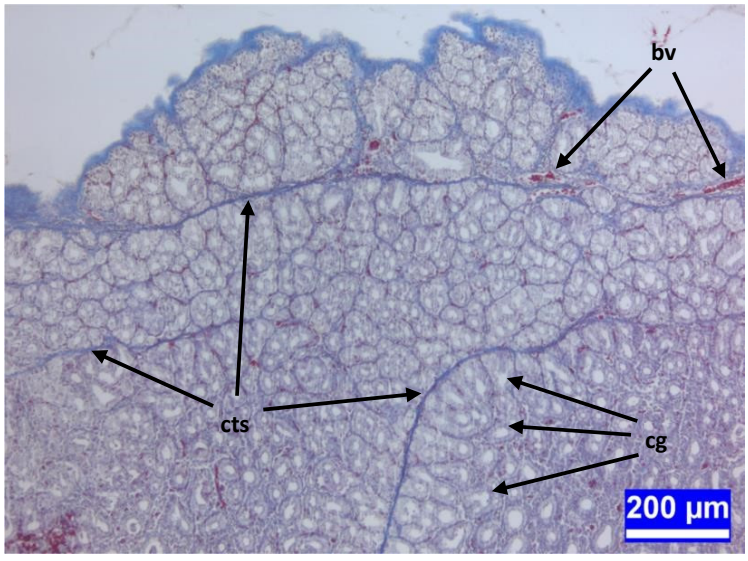

Figure 4. Thin connective tissue septum (cts) between the lobules in the Harderian gland of a 3-month-old *A. chukar* (triple staining)

Cg: Corpus glandulae; Bv: Blood vessel.

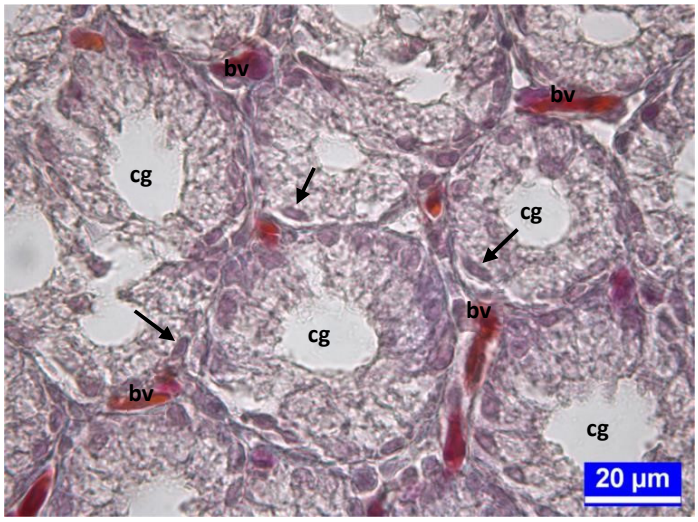

Figure 5. The corpus glandulae within the lobules of the Harderian gland of a 3-month-old *A. chukar*

Cg: Corpus glandulae; Bv: Blood vessel.

Note: Myoepithelial cell nucleus (arrows) (triple staining).

In PAS staining, there were very weak PAS-positive cells in the epithelial cells forming the corpus glandula (Figure 18). There were epithelial cells showing a weak PAS-positive reaction on the epithelial cells of the main draining channel (Figure 19) and on the apical surface of the epithelial cells forming the primary draining channel (Figure 20).

The corpus glandulae epithelial cells showed a significant AB-positive reaction in the PAS/AB pH=2.5 staining (Figure 21). In the primary draining channel, most epithelial cells showed a strong AB-positive reaction, while a few epithelial cells showed a PAS-positive reaction (Figure 22). Most main draining channel epithelial cells showed an AB-positive reaction, while a few cells showed a PAS/AB-positive reaction (Figure 23).

Discussion

In our study, henna partridges Harderian gland was found to be located at the medial eye angle within the bulbus oculi. The Harderian gland was light pink, had concave and convex faces that matched the shape of the bulbus oculi. The gland had a smooth surface resembling half-moon, and had no relationship with CPT. Beheiry et al. (2020) reported that the gland appears in a pointed oval shape in pigeons. El-Leithy et al. (2015) reported

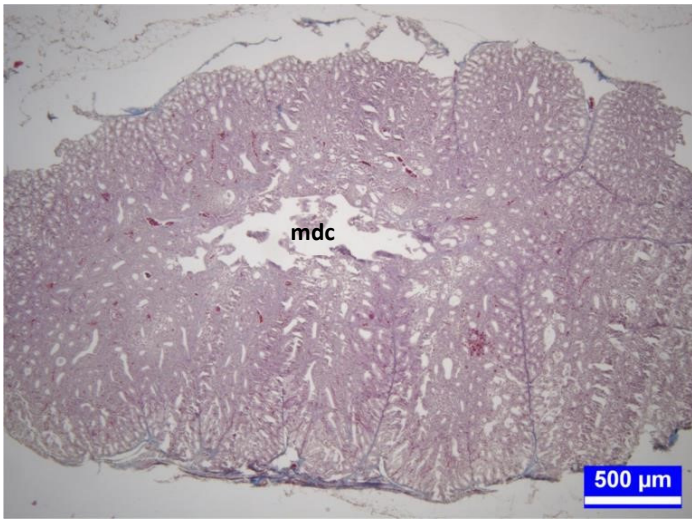

Figure 6. The main draining channel (mdc) in the Harderian gland of a 3-month-old *A. chukar* (triple staining)

Figure 7. The main draining channel (mdc) in the Harderian gland of a 3-month-old *A. chukar* (triple staining)

Note: Single layer cubic epithelial cells (arrows).

that the adult male rabbit Harder gland consists of two lobes (large pink lobe and small white lobe).

Çalışlar (1984) reported that the Harderian gland is not related to the CPT in chicken as it is in other domestic animals, such as pigs and cattle, and that it is significantly larger and more developed compared to the glandula lacrimalis. It is pinkish, light brown, almost red, and has an irregular rectangular shape which fits the bulbus oculi's shape. The organ's structure was described in a similar way by Fourman and Ballatyn (1967) in geese, by Brobby (1972) in domestic ducks, by Altunay and Kozlu (2004) in ostriches, by Boydak and Aydın (2009) in domestic geese, by Mobini (2012) in domestic chickens, by Önal and Çınar (2013) in henna partridges, by Bejdic et al. (2014) in laying hens, and by Kleckowska et al. (2015) in Bilgorajska geese.

According to Çalışlar (1984), a thin capsule of connective tissue surrounds the chicken Harderian gland which has one main duct along its longitudinal length. According to a study conducted by Brobby (1972) on domestic ducks, a connective tissue capsule containing smooth muscle cells, nerve fibers, tight collagen fibers,

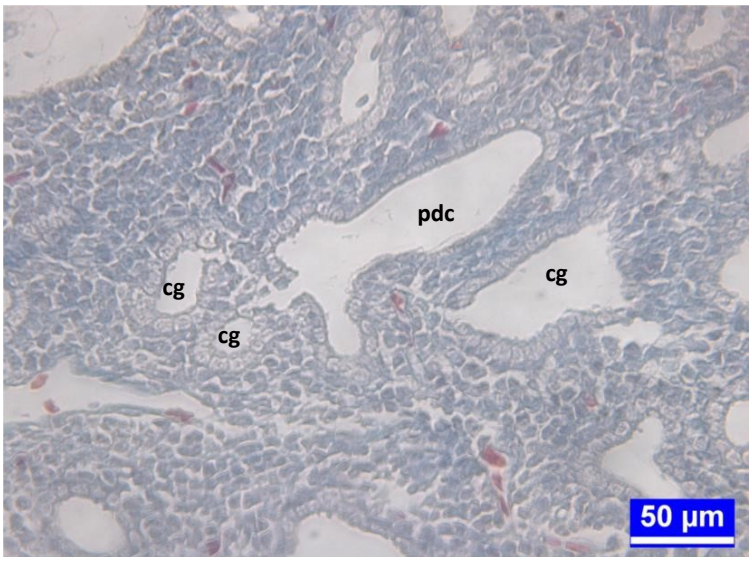

Figure 8. Primary draining duct (pdc) in the lobules of Harderian gland of a 6-month-old *A. chukar* (triple staining)

Cg: Corpus glandula.

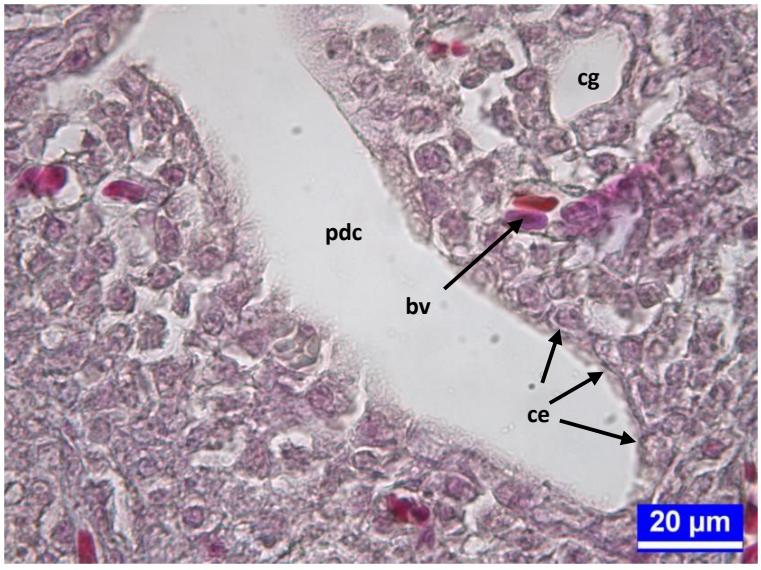

Figure 9. Primary draining channel (pdc) in the lobules of the Harderian gland of a 3-month-old *A. chukar* (triple staining)

Abbreviations: Cg: Corpus glandula; Ce: Cuboidal epithelium; Bv: Blood vessel.

and blood vessels surrounds Harderian gland. According to studies conducted on domestic geese by Boydak and Aydın (2009), ostriches by Kozlu et al. (2010), and domestic chickens by Mobini (2012), a thin connective tissue capsule surrounds the harderian gland. Mobini (2012) stated that domestic chicken Harderian gland has blood vessels, parasympathetic nerve cords, collagen, elastic, and reticular fibers. Boydak and Aydın (2009) revealed that the connective tissue capsule of domestic goose had collagen and reticular fibers and Kozlu et al. (2010) stated that Harderian gland of ostrich had collagen and reticular fibers. Kleckowska-Nawrot et al. (2015) reported that the harder gland of the European bison (order: Artiodactyla; class: Bovidae) is covered

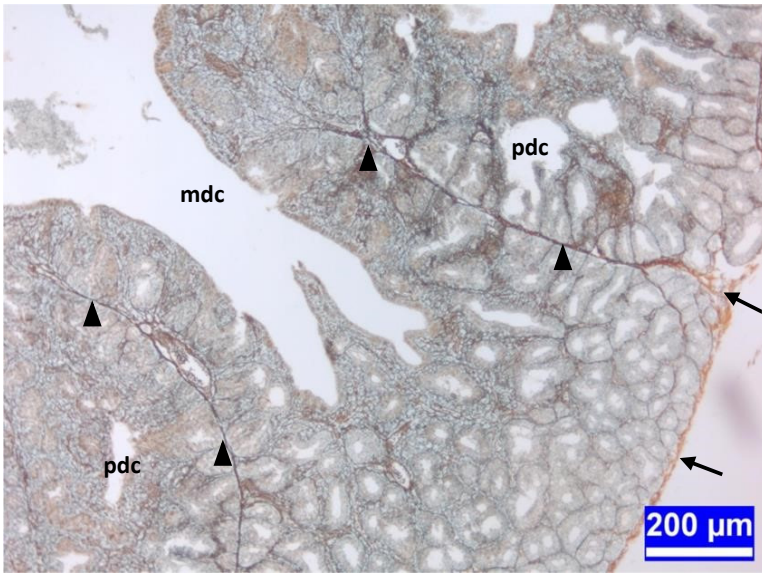

Figure 10. Reticular threads in the 3-month-old *A. chukar* harder gland.

Pdc: Primary draining channel; Mdc: Main draining channel.

Note: Gordon-Sweet (GS) staining.

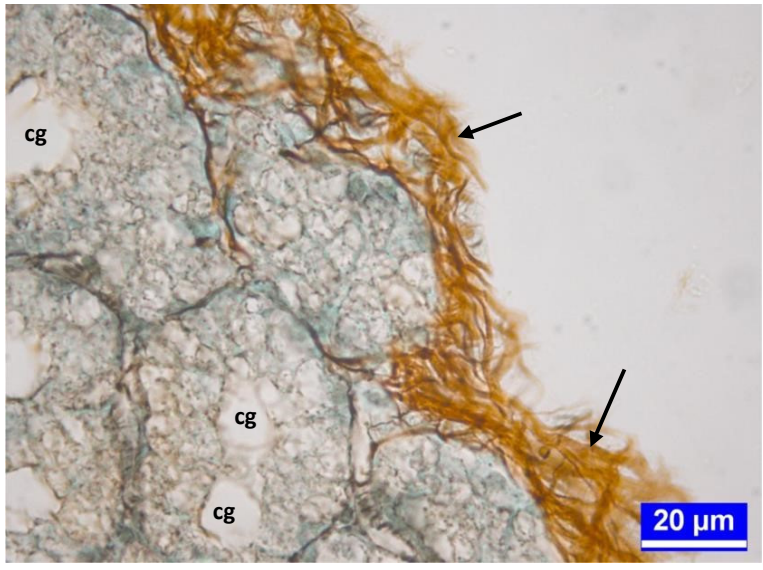

Figure 11. Reticular fibers (arrows) in the connective tissue surrounding the organ externally in the Harderian gland of a 6-month-old *A. chukar*

Cg: Corpus glandula.

Note: Gordon-Sweet (GS) staining.

with a thick connective tissue capsule consisting of collagen and elastic fibers. Rajathi et al. (2018) reported that a thin connective tissue capsule surrounds the gland in goats and septa divide the gland into lobes and lobules. According to Liman and Gülmez's (1996) study on French white geese, the organ's size and volume expanded on the 21st day of hatching, and the connective tissue between the lobules thickened together with the capsule. This study revealed that a thin connective tissue capsule containing smooth muscle fibers, nerve fibers, tight collagen fibers, reticular fibers, and blood vessels surrounds the henna partridge Harderian gland.

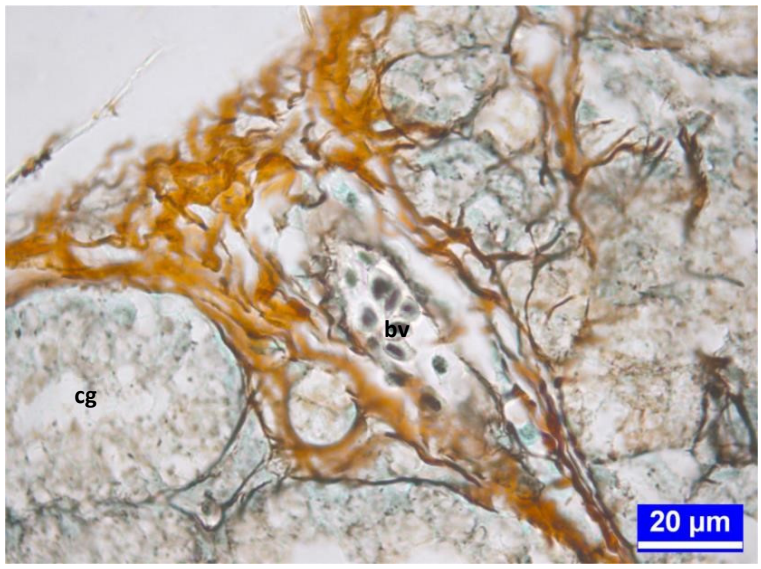

Figure 12. In the Harderian gland of a 6-month-old *A. chukar*, reticular fibers forming a network in areas where connective tissue septums enlarging

Bv: Blood vessel; Bg: Corpus glandula.

Note: Gordon-Sweet (GS) staining.

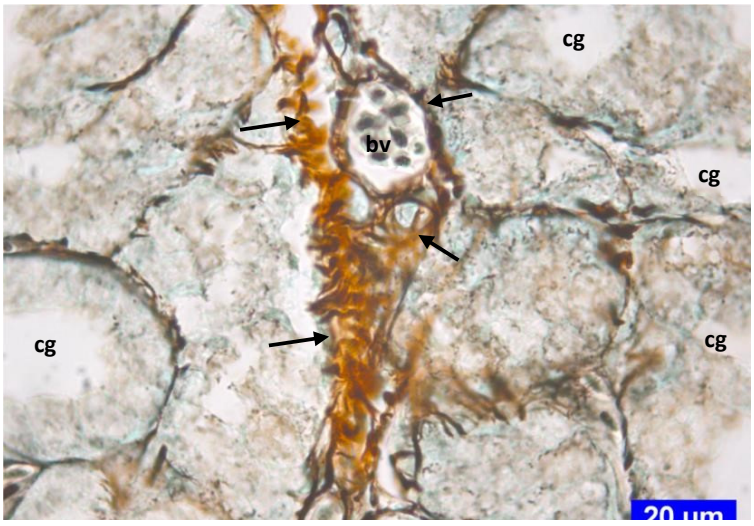

Figure 13. Reticular fibers (arrows) around the blood vessel (bv) in the harderian gland of a 6-month-old *A. chukar*

Cg: Corpus glandula.

Note: Gordon-Sweet (GS) staining.

Studies conducted on mice (Watanabe 1980), rats (Djeridane, 1994), French white geese (Liman & Gülmez 1996), desert lizards (Sabry & Al-Ghaith 2000), ostriches (Altunay & Kozlu 2004), mallard ducks (Dimitrov & Nikiforov, 2005), armadillos (Marcos & Affanni 2005), piglets (Munkeby et al., 2006), broilers and domestic chickens (Khan et al. 2007), domestic geese (Boydak & Aydın, 2009), ospreys (Kozlu et al., 2010), domestic chickens (Mobini, 2012), and henna partridges (Önal & Çınar, 2013) show that the Harderian gland is divided into lobes and lobules by the capsule that surrounds it. In this study, it was found that septums are sent into the gland by the connective tissue capsule that surrounds the organ. The gland is divided into lobes by these connective tissue partitions and the lobes are further divided into smaller lobules by thinner connective tissue septums that are separated from the interlobar septums. Medium-sized blood vessels and nerve wires were also detected in the corners where the lobes contacted each other.

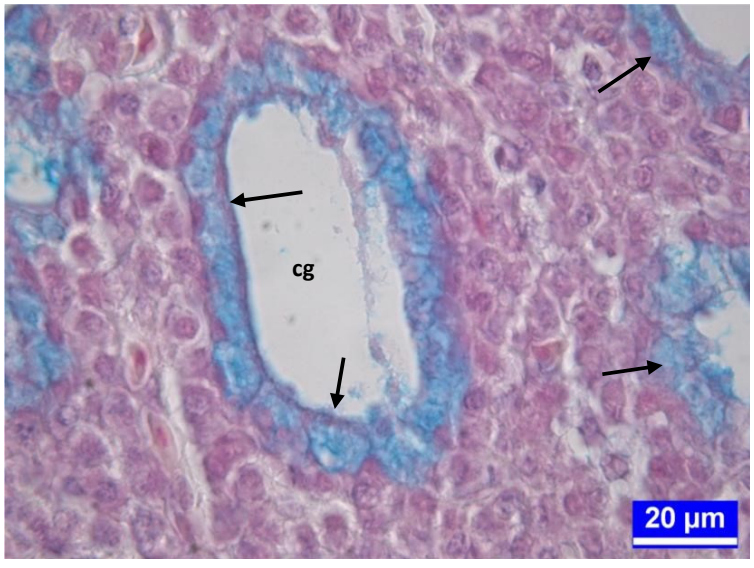

Figure 14. Corpus glandula epithelial cells in the 3-month-old *A. chukar* harder gland

Note: Alcian Blue (AB), pH=2.5 staining.

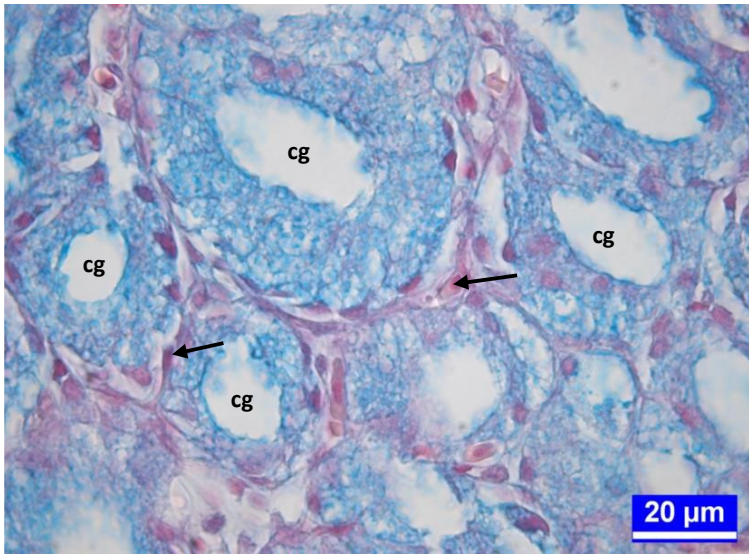

Figure 15. Corpus glandulae (cg) showing strong ab-positive reaction in the Harderian gland of a 3-month-old *A. chukar*

Note: Myoepithelial cell nuclei (arrows), Alcian blue (AB) pH=2.5 staining

In studies conducted on mice (Watanabe, 1980), rats (Djeridane, 1994), French white geese (Liman & Gülmez 1996), desert lizards (Sabry & Al-Ghaith 2000), tree shrews (Pradidarcheep et al., 2003), ostriches (Altunay & Kozlu 2004), ospreys (Kozlu et al., 2010), mallards (Dimitrov & Nikiforov, 2005), armadillos (Marcos & Affanni, 2005), piglets (Munkeby et al., 2006), broilers and domestic chickens (Khan et al., 2007), dolphins (Ortiz et al., 2007), domestic geese (Boydak & Aydın, 2009), domestic chickens (Mobini, 2012), henna partridges (Önal & Çınar, 2013), and *Meriones libycus* (Hanniche et al., 2019) Harderian gland was reported to have a compound tubuloalveolar structure. In this study, it was observed that Harderian gland of henna partridge has a compound tubuloalveolar structure.

Brobby (1972) stated that the corpus glandulae of domestic duck Harderian gland were branched and secreted into a central lumen. Boydak and Aydın (2009) reported that domestic geese had a corpus glandular lumen into

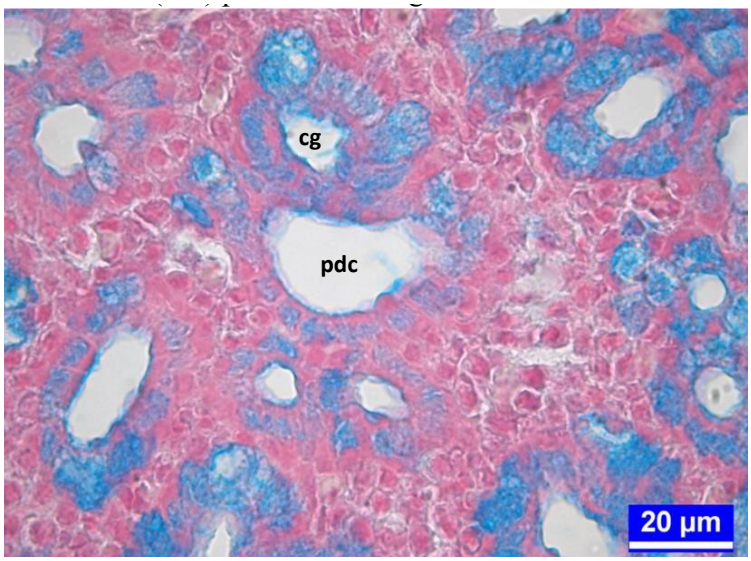

Figure 16. Primary draining channel (pdc) with AB-positive epithelial cells in the Harderian gland of a 3-month-old *A. chukar*

Cg: Corpus glandula.

Note: Alcian blue (AB) staining, pH=2.5.

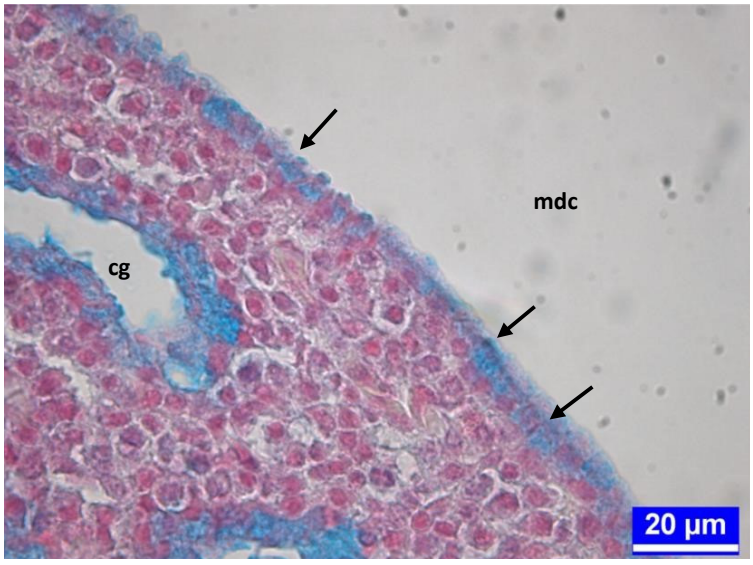

Figure 17. Main draining channel (mdc) epithelial cells (arrows) showing ab-positive reaction in the Harderian gland of a 3-month-old *A. chukar*

Cg: Corpus glandula.

Note: Alcian blue (AB) staining, pH=2.5.

which the Harderian gland folded. Sakai (1981) reported that Harderian gland comprised many lobes gathered around a central duct, each of which had a central lumen and corpus glandulae were radially directed towards the lumen. According to this study, the corpus glandulae of Harderian gland of henna partridge are branched, and the epithelial cells forming the corpus glandulae secret into the central lumen. It was observed that the henna partridge Harderian gland comprises many lobes that are gathered around the main draining channel, each of which has a primary duct around which corpus glandulae are arranged.

The studies conducted on turkeys by Maxwel et al. (1986), on French white geese by Liman and Gülmez (1996), on ostriches by Altunay and Kozlu (2004), on

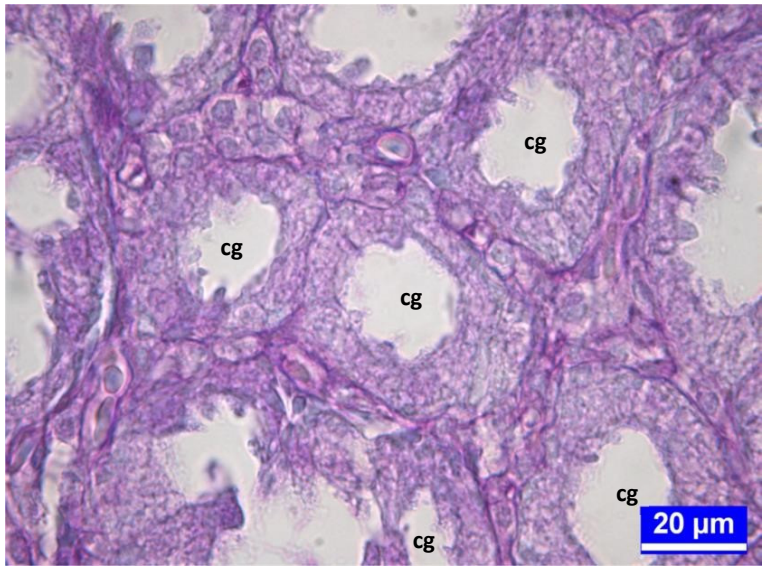

Figure 18. Corpus glandula epithelial cells in the 3-month-old *A. chukar* harder gland

Note: Periodic acid-Schiff (PAS) staining.

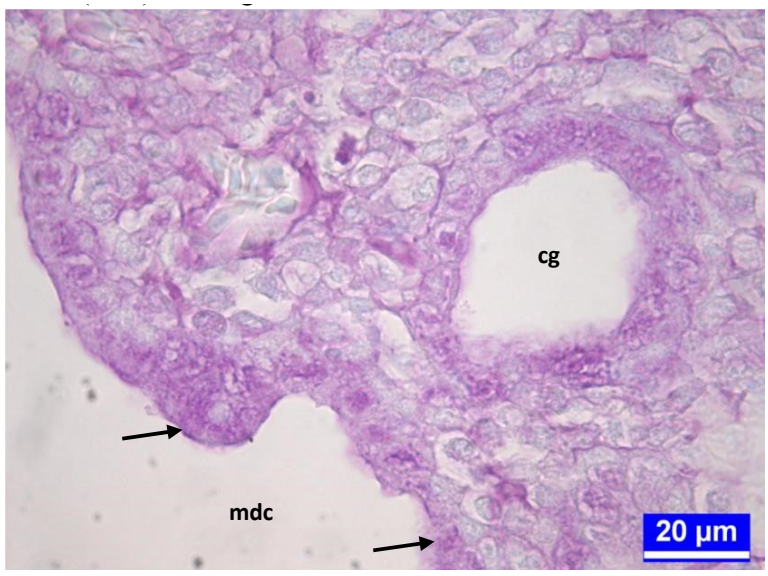

Figure 19. Main draining duct epithelial cells in the 6-month-old *A. chukar* harder gland

Cg: Corpus glandula; Mdc: Main draining channel.

Note: Periodic acid-schiff (PAS) staining.

female pheasants by Yaren (2008), on domestic geese by Boydak and Aydın (2009), on ospreys by Kozlu et al. (2010), and on domestic chickens by Mobini (2012) reveal that the corpus glandulae in Harderian gland are covered with high prismatic epithelial cells. Önal and Çınar (2013) reported that the corpus glandulae in the Harderian gland of henna partridge consist of low or high prismatic epithelial cells. In this study, it was determined that the corpus glandulae of henna partridge Harderian gland consists of low or high prismatic epithelial cells.

Fathel-bab et al. (1991) pointed out that myoepithelial cells were found in camels between the secretory epithelial cells and the basement membrane. Maxwell et al. (1986) reported that myoepithelial cells were under the columnar secretory epithelium and associated with the basement membrane in turkeys. Rothwell et al. (1972)

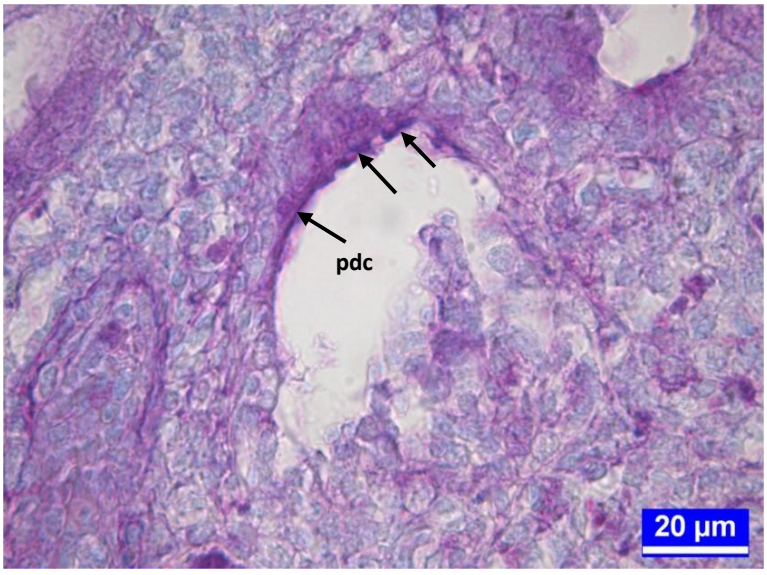

Figure 20. Primary draining duct in the 6-month-old *A. chukar* harder gland

Note: Periodic acid-Schiff (PAS) staining.

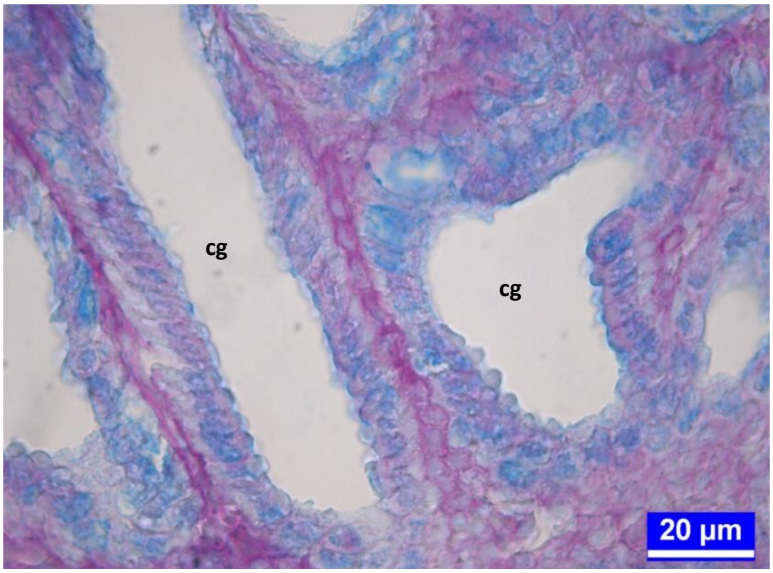

Figure 21. Corpus glandulae containing strongly AB-positive epithelial cells in the Harderian gland of a 3-month-old *A. chukar*

Cg: Corpus glandulae.

Note: Periodic acid-Schiff (PAS)/Alican blue (AB), pH=2.5 staining.

reported that myoepithelial cells were between the secretory epithelium and their basal lamina in domestic chickens. Chiquoine (1958) conducted the most comprehensive study on this subject and obtained significant information. In this study, myoepithelial cells were detected on the epithelial cells basal surfaces forming the wall of the corpus glandulae and draining channels of the henna partridge Harderian gland.

In the studies conducted on Harderian gland of domestic geese by Boydak and Aydın (2009), ospreys by Kozlu et al. (2010), and domestic chicken by Mobini (2012), epithelial cells of the corpus glandula are revealed to lack goblet cells. In this study, no goblet cells are observed among the corpus glandula epithelial cells in Harderian gland of henna partridge. Goblet cells are detected among the epithelial cells of the main draining channel.

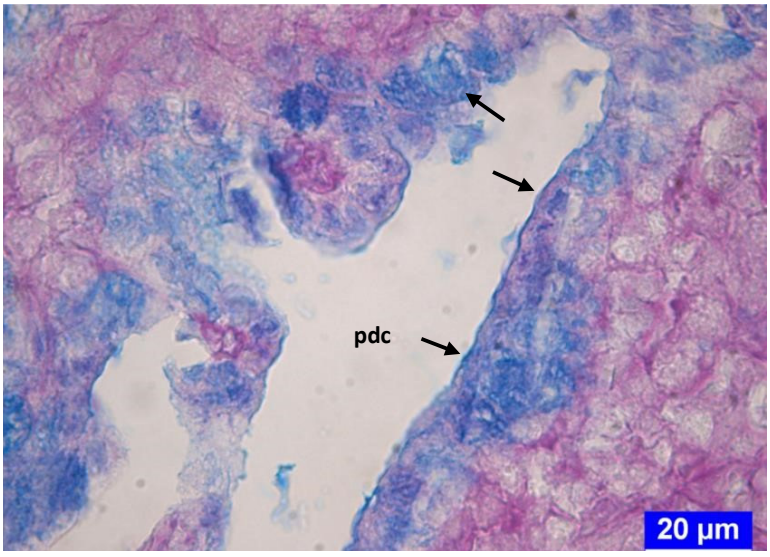

Figure 22. AB-positive reaction in the primary draining channel (pdc) epithelial cells in the Harderian gland of a six-month-old *A. chukar*

Note: Epithelial cells (arrows), Periodic acid-Schiff (PAS)/Alican Blue (AB), pH=2.5 staining.

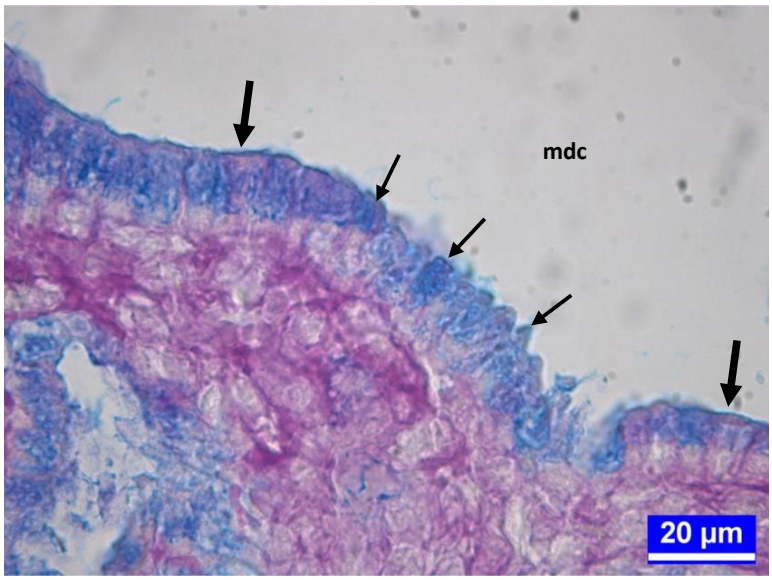

Figure 23. Main draining duct epithelial cells in the 6-month-old *A. chukar* harder gland

Note: Periodic acid-Schiff (PAS)/Alican blue (AB), pH=2.5 staining.

The studies on female pheasants by Yaren (2008), on domestic geese by Boydak and Aydın (2009), on ospreys by Kozlu et al. (2010), on domestic chickens by Mobini (2012), on henna partridges by Önal and Çınar (2013) reveal that each lobe in the harderian gland has a single central duct with a very large lumen together with the primary draining channel. This study shows that each lobe has a single central duct with a very large lumen along with the primary draining channels.

The study by Yaren (2008) on female pheasants reveals that while the epithelial cells in the primary duct has a single-layered prismatic structure, the epithelial cells in the main draining channel has a single-layered cuboidal epithelial structure. In their study, Önal and Çınar (2013) reported that the epithelial cells in the main draining channel and primary draining channel in the henna partridge Harderian gland had a single-layered cuboidal epithelial structure. Similarly, in our study, it was found that both draining channel epithelial cells had a single-layered cuboidal structure.

It was reported that the secretory character of epithelial cells in the corpus glandulae is serous-mucous in turtles (Chieffi et al., 1992b), mucous in female pheasants (Yaren, 2008), mucous in quails (Kozlu & Altunay, 2011), mucous in the alveolar part, and serous towards the tubular part in henna partridges (Önal & Çınar, 2013). In this study on henna partridges, it was found that the epithelial cells in the tubular part of the corpus glandulae were serous and mucous towards the alveolar part.

In domestic ducks (Brobby, 1972) and ospreys (Kozlu et al., 2010), corpus glandular epithelial cells show a weak PAS-positive and strong AB-positive reactions in PAS and AB staining. In female pheasants (Yaren, 2008), corpus glandula epithelial cells show a weak PAS-positive reaction in PAS staining, a strong AB-positive reaction in AB pH=2.5 staining, and a PAS/AB-positive reaction in PAS/AB pH=2.5 combined staining. Önal and Çınar (2013) reported that corpus glandula epithelial cells in henna partridges showed moderate intensity at AB pH=0.5, strong reaction at AB pH=1.0, only AB-positive reaction in PAS/AB pH=2.5 staining, and strong AF-positive reaction as a result of Aldehyde Fucsin (AF) application. In AF/AB staining, acidic mucosubstance was detected in a small number of cells with a co-dominant reaction and it showed no reaction in PAS staining. Liman and Gülmez (1996) stated that the corpus glandular epithelial cells of Harderian gland in French white geese were stained blue in PAS/AB pH=2.5 combined staining and that they contained acid mucins. Sakai (1981) conducted a study on the secretions of Harderian glands of the thrush, English sparrow, red-winged black bird, farm sparrow, duck, chicken, turkey, pheasant, finch, and mourning dove and reported that Harderian gland corpus gland epithelial cells showed mucoid character in PAS staining and negative character in Sudan black staining. Hussein et al. (2015) detected the presence of neutral mucins in harder gland cells in adult guinea pigs. In this study, corpus glandular epithelial cells showed strong AB-positive reaction in AB pH=2.5 staining, very weak PAS-positive reaction in PAS staining and strong AB-positive reaction in PAS/AB pH=2.5 combined staining.

In domestic ducks (Brobby, 1972), the epithelial cells of the main draining channel show different degrees of PAS/AB-positive reaction. Yaren (2008) reported that primary and main draining channel epithelial cells in female pheasants showed a weak PAS-positive reaction in PAS staining, strong AB-positive reaction in AB pH=2.5 staining, and PAS/AB-positive reaction in PAS/AB pH=2.5 staining. Önal and Çınar (2013) reported that epithelial cells of the primary draining channel in the Harderian gland of henna partridge showed a weak PAS-positive reaction in PAS staining, a weak and strong AB-positive reaction in AB pH=2.5 staining, AB-positive reaction in PAS/AB pH=2.5 staining, and PAS-positive reaction in the majority of epithelial cells and PAS-positive reaction in a few cells. Khayoon et al. (2019) reported that in histochemical staining with PAS/AB (pH=2.5), the cytoplasm of the columnar cells in the lining epithelium of the secretory units and the central canal reacted positively only with AB staining. In this study, a strong AB-positive reaction was found in the majority of primary draining channel epithelial cells, a weak PAS-positive reaction was found in a small number of cells in PAS staining, and a strong AB-positive reaction was found in the majority of epithelial cells and PAS-positive reaction was found in a small number of epithelial cells in PAS/AB pH=2.5 staining.

In turkeys, ducks, and chickens (Burns & Maxwell, 1979), it was reported that mucus cells in the epithelial cells of the main draining channel showed a weak PAS-positive reaction in PAS staining and a strong reaction at AB pH=1 and AB pH=2.5. This study indicates that goblet cells in the epithelial cells of the main draining channel show a weak and strong AB-positive reaction in AB pH=2.5 staining method and a weak PAS-positive reaction in the PAS staining method.

Conclusion

In accordance with the this study findings, no significant difference is found in terms of general histological structure and histochemical properties of 3- and 6-month-old henna partridge Harderian gland. However, it is important to confirm this issue in different poultry species. We also recommend scientists interested in this study to include micrometric measurements in their studies.

Ethical Considerations

Compliance with ethical guidelines

Before the study, the approval was obtained from the Ethics Committee of Selcuk University, Faculty of Veterinary Medicine (SUVFEK) (Dated on March 25, 2015 and No.: 2014/11).

Funding

This study was supported by the Selcuk University, Scientific Research Project Fund (Grand No.: 2014/03).

Authors' contributions

All authors equally contribute to preparing all parts of the research.

Conflict of interest

The authors declared no conflict of interest.

Acknowledgments

The authorrs express their gratitude to Selcuk University for the support.

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