

Article

Histological Structure of the Vascular layer and the Retina layer of Eye in Iraqi blacked partridge *Francolinus francolinus* (Linnaeus,1766)

Ahmed Mustafa Ahmed¹, Mohammed A . Mahdi²

¹College of Dentistry, Al-Iraqia University, Baghdad, Iraq

²College of Dentistry, Al-Iraqia University, Baghdad, Iraq

*Correspondence: ahmed.mu.ahmed@aliraqia.edu.iq ; ORCID: 0000-0003-3414-3205, mohammed.a.mahdi@aliraqia.edu.iq;

ORCID: 0009-0009-7407-7549

Citation: Ahmed, A. M & Mahdi, M. A. Histological Structure of the Vascular layer and the Retina layer of Eye in Iraqi blacked partridge *Francolinus francolinus* (Linnaeus,1766). American Journal Of Bioscience And Clinical Integrity 2026, 3(4), 109-118

Received: 10th Jan 2026

Revised: 21th Feb 2026

Accepted: 14th Mar 2026

Published: 28th Apr 2026



Copyright: © 2026 by the authors. Submitted for open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>)

Abstract: Objective :The present study aimed to identify the histological structure of the vascular layer and retina layer in the eye of the Iraqi blacked partridge *Francolinus francolinus* . Methods : Using five adult birds samples, 10% formalin solution was used to anesthetize the animals, anatomicize the samples, and perform a number of histological staining procedures. Results : The choroid, ciliary body, and iris are the three components that make up the vascular layer of the eye. The choroid is loose, vascularized connective tissue, and also contains many pigment cells, and consists of several layers including, Epichoroid lamina , choriocapillary layer and Bruch's membrane. the ciliary body, which was attached anteriorly to the iris, served as the choroid's anterior support structure. The ciliary body encompassed the stroma, epithelium, and smooth muscles fibers .The ciliary epithelium consisted of two cell layers. The nonpigmented innermost section of the epithelium. A pigmented outer ciliary epithelium connected to the pigmented retinal epithelium.The stroma is ahighly ,vascularized ,loose connective tissue layer, situated between the ciliary muscle and the epithelial layer ,directly continous with iris stroma anteriorly and choroid posteriorly, it contains blood vessels ,fibroblasts ,and pigmented cells .The iris's anterior surface is covered with a thick layer of Pigmented cells and fibroblasts. The stroma contained blood vessels, smooth muscles, whereas the two layers of epithelium protecting the ciliary processes are continuous on the posterior surface. The retina consisted of two parts: a nonsensory region and a sensory section. The retina's ten layers made up its sensory portion: first layer is the epithelium ant it is called retinal pigmented , second layer is rods and cones , the third layer is the membrane which is called external limiting, the fourth layer is external nuclear, the fifth layer is called external plexiform, the sixth layer , which is called internal nuclear, and seventh in the arrangement of the layers of the retina is called internal inner plexiform, the eighth layer of the retina is ganglion cell , the ninth layer is called nerve fibers, finally inner limiting membrane

Keywords: *Francolinus francolinus.*, Histological, Retina, Vascular layer.

Introduction

The Iraqi blacked partridge belongs to the order Galliformes of the family Phasianidae (Mahdi and George, 1969). Vision is considered one of the most important senses for all bird species because it is necessary for environmental adaptation [1]. Birds have a pair of eyes located on the side of the head, each eye located within an orbit [2]. Birds have binocular vision with their front eyes as in the owl, enabling them to judge distances for hunting. While the birds with eyes on both sides of their heads have a wide visual field that helps identify predators [3]. Birds have a third eyelid called nictitating membrane which lubricates the birds' eyes by sweeping it horizontally across the eye [4]. In many aquatic birds, the nictitating membrane serves as a contact lens when the birds are underwater. The eye is cleaned by tear secretions from the lacrimal gland and protected by an oil substance from the Harderian gland which covers the cornea and prevents it from drying out [5]. Similar to other vertebrates, birds' eyes have three layers, the tunica fibrosa is the first layer which consists of sclera and cornea, the tunica vasculosa is the second layer which includes the first choroid, the second ciliary body and the third iris, while the third layer is the tunica nervosa consisting of retina which connects with the cerebrum through the posterior optic nerve [2], [6], [7]. The retina is a sensitive and complex tissue, consisting of several layers in addition to the existence of cells in charge of absorbing light and transmitting it to the brain as a nerve impulse to form a visual image [8].

Materials and Methods

Collecting Samples and Anatomical Part

A total of five birds were to be obtained and purchased at the Al-Gazal market in Baghdad after examined as negative from any infections or diseases. In the research, the birds were anesthetized with chloroform, the skull was broken after the feathers were clipped with scissors. The skull bones were extracted and carefully split apart. Sharp scissors and delicate forceps were also used to cut the brain's related nerves. After being taken out of orbit, the eye was cleaned and placed in a petri dish with filter paper.

Histological preparation

The sample was put in a container with 10% buffered formalin solution and left for 48 hours in order to analyze the histology of the eye. Running water was used to remove the 10% buffered formalin solution fixative in order to avoid interfering with the subsequent processes.

Following that, samples were placed in ethyl alcohol concentrations that ranged from 70, 80, 90 and 100%, for two hours at a time in order to extract water from the sample tissues. Ultimately, the samples underwent modifications in xylene for 45 minutes. The samples were then placed in a 1:1 mixture of xylene and paraffin wax for 15 minutes in an electric oven at 58°C. Samples were embedded by first immersing them for two hours in paraffin wax, and then impregnating them with paraffin wax for the entire night. The sample was subsequently sectioned using a microtome. Five micrometers was the sample's thickness. The sample sections were loaded onto the slides and fixed there with albumin. Sample sections-loaded slides were on a hot plate. The specimens were processed for histological staining. Harris's hematoxylin and eosin stain were used to examine the general structure [9].

Results and Discussion

Results

Vascular layer or Uvea

The current study's findings demonstrated that the vascular layer in the eye of the *Francolinus francolinus* represents the middle layer, which lies between the fibrous layer and the retina layer, it appears to be composed of three main parts, namely: the first choroid, the second ciliary body, and the third iris.

Choroid

The study results explained that the choroid layer appears more vascular and consists of several layers including the Epichoroid lamina, choriocapillary layer and Bruch's membrane. The Epichoroidal layer appears to be composed of thin collagen fibers, pigmented cells, elastic fibers and fibroblasts. The next layer is called choriocapillary layer and it is composed of many blood vessels and

connective tissue between these vessels contains melanocytes. The choroid layer is separated from the retinal pigment epithelium by a thin membrane called Bruchs memberane, which lies below the choriocapillary layer(fig1).

Ciliary body

The study result showed that the ciliary body, which was attached anteriorly to the iris, served as the choroid's anterior support structure, It has a large surface area and several thick folds. The ciliary body encompassed the stroma, epithelium, and smooth muscles fibers(fig2).The ciliary epithelium consisted of two cell layers. The nonpigmented innermost section of the epithelium. A pigmented outer ciliary epithelium connected to the pigmented retinal epithelium.The stroma is ahighly ,vascularized ,loose connective tissue layer, situated between the ciliary muscle and the epithelial layer ,directly continous with iris stroma anteriorly and choroid posteriorly, it contains blood vessels ,fibroblasts ,and pigmented cells .The ciliary body contains a smooth muscle fibers that play an important role in adapting visin (fig3).

Iris

The iris occupies the anterior part of the vascular layer and surrounds the pupil ,it is considered the last part of this layer and appears to be elongated in shape . The anterior surface comprises of layer of fibroblasts and pigmented cells . The stroma comprised blood arteries, smooth muscle fibers, and fibroblasts derived from loose connective tissue. The iris's posterior surface is covered in a two-layered epithelium that is strongly melanin-filled and continuous with the ciliary processes(fig4).

Retina

The current study clarified that the retina is the innermost layer of the eyeball. The retina consisted of two parts: a nonsensory region and a sensory section. This nonsensory region of the retina begins at the iris after passing via the ciliary body.The retina's ten layers made up its sensory portion: first layer is the epithelium ant it is called retinal pigmented , second layer is rods and cones , the third layer is the membrane which is called external limiting , the fourth layer is external nuclear, the fifth layer is called external plexiform , the sixth layer, which is called internal nuclear, and seventh in the arrangement of the layers of the retina is called internal inner plexiform , the eighth layer of the retina is ganglion cell , the ninth layer is called nerve fibers, finally inner limiting membrane (Fig5).The results of the current study showed that the pigment cell layer is the outer layer and represents the first layer of the retina, it consist of cuboidal epithelial cells arranged in a single row with a prominent nucleus and which is based on the basement membrane, numerous cytoplasm extensions extend between the visual cells and are characterized by containing pigment granules that give them a dark color(fig 6).There is a layer of rods and cones that are sensitive to light and adjacent to the pigmented epithelial cells . Each one has an inner portion and an outside component that overlaps and extends the pigmented epithelial cells . The outer part of the cones is conical in shape and wider ,while the rods appear thin and cylindrical in shape. External limiting membrane is lighter in color and separated the layer of rods and cones from the outer nuclear layer (fig6).The external nuclear layer contains the elongated nuclei of rods and cones, number of rows of cells is between 2 – 3(fig6).The thin layer known as the external plexiform layer served as a barrier between the inner and outer nuclear layers, the dendrites of both bipolar and horizontal cells entwine with the axons of photoreceptor (rod and cone) in the outer plexiform layer(fig6).The internal nuclear layer is characterized by containing a large number of cells that are tightly packed and diverse ,and composed of horizontal cells , bipolar cells and amacrine cells, number of rows shown from 14-16 in *Francolinus francolinus*(fig6).The results show that innermost layer of the inner plexiform layer is thicker than outermost plexiform layer, and consists of interconnected axons of amacrine and bipolar cells with dendrites of the ganglion cells(fig6).The ganglion cell layer is the deepest cellular layer in the retina and consists of two rows of cells, its cells appear large in size with a clear nucleus(fig6).Axons congregate in ganglion cells to form the layer of nerve fiber, which thickens as it descends to form the nerve that leaves the eye and travels to the brain(fig6).inner limiting membrane it appears as a very thin membrane that separates the retina from the vitreous fluid(fig6).The study results showed the presence of a concave area in the dorsal region of the retina called the fovea, which is important inproviding high-reslution vision and image carity ,and contains a large number of photoreceptre(fig7).

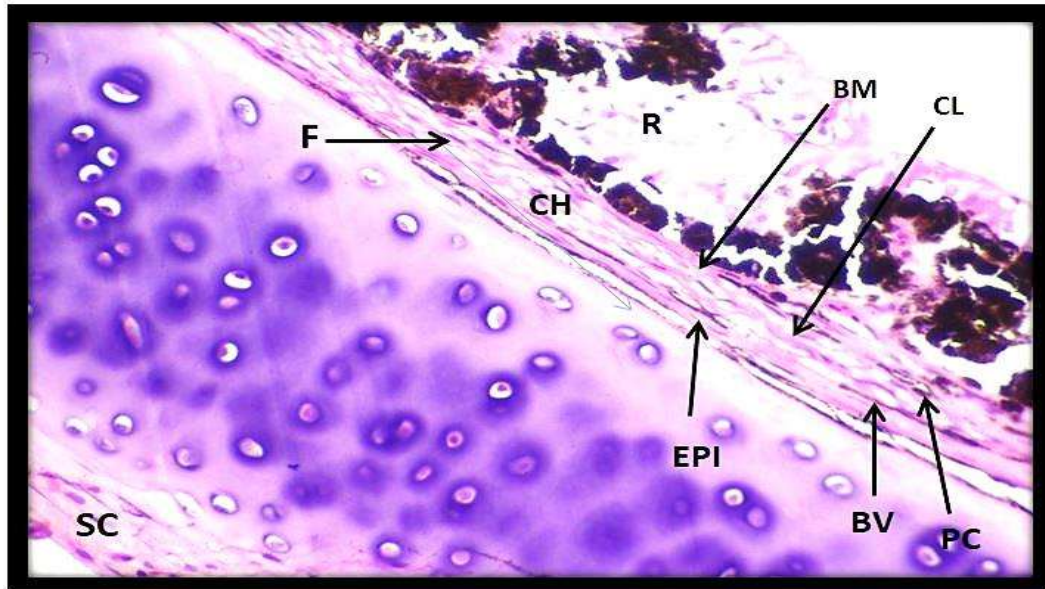


Fig 1 : Histological section showing the Choroid in Iraqi blacked partridge *Francolinus francolinus*: Epichoroid (EPI) , Choriocapillary layer(CL) , Bruch memberane(BM) , Fibroblast(F) , Blood vessels (BV), Pigmented cells (PC) Retina(R).H and E 40X

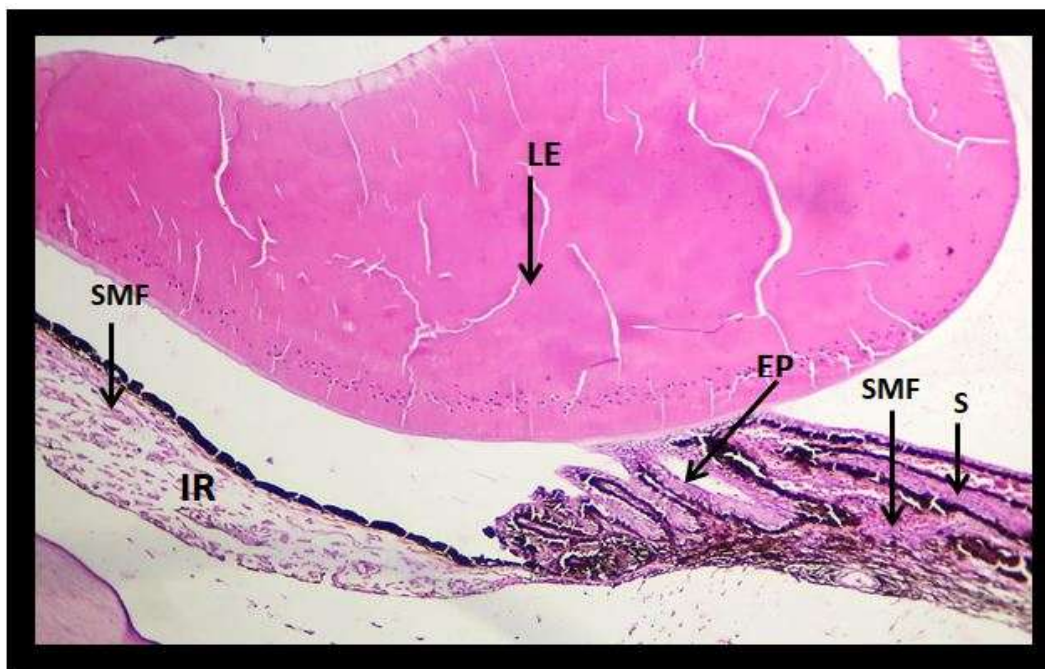


Fig 2 : Histological section Showing the Ciliary body in Iraqi blacked partridge *Francolinus francolinus* , Epithelium(EP) Stroma (S) , Smooth muscle fibers (SMF) , Iris(IR) , Lens (LE).H and E 10x.

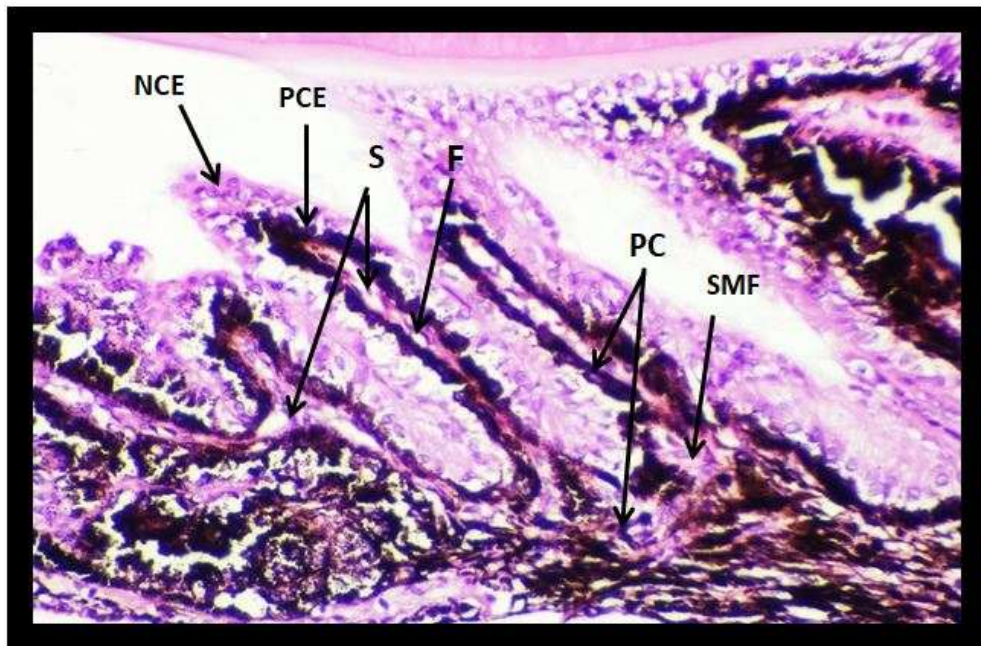


Fig 3 : Histological section Showing Non - pigmented ciliary epithelium(NCE) , pigmented ciliary epithelium (PCE) , Stroma(S) ,Pigmented cells(PC) , Blood vessels(BV) , Fibroblast (F) , Smooth Muscle fiber(SMF) .H and E 40X

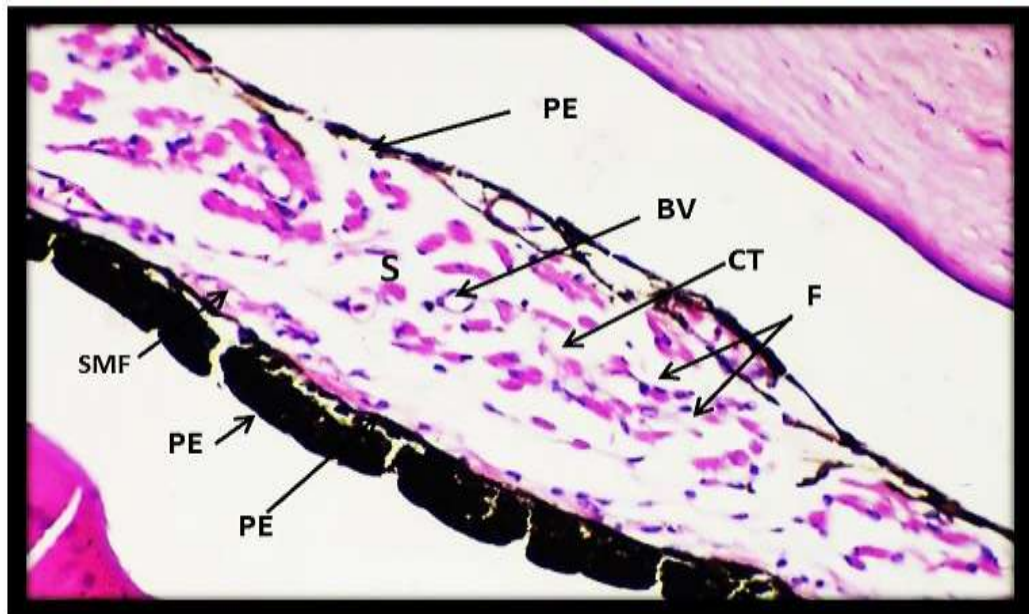


Fig 4 : Histological section Showing the Iris in Iraqi blacked partridge *Francolinus francolinus*: Pigmented epithelium(PE) , Stroma (S), Fibroblast(F) , Blood vessels(BV) , Smooth muscle fibers(SMF) . Connective tissue(CT) .H and E 40X.

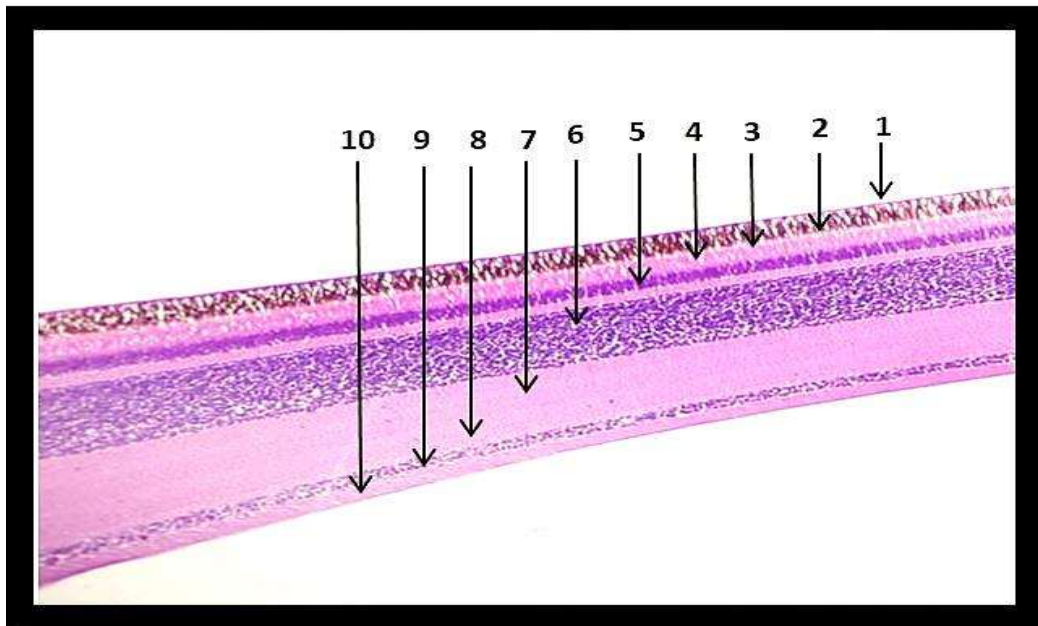


Figure (5) : Histological section Showing the layers of the retina in Iraqi blacked partridge *Francolinus francolinus* (1) Pigmented epitheliuml layer, (2) Rod and cones layer, (3) External limiting membrane, (4) External nuclear layer, (5) External plexiform layer, (6) Internal nuclear layer, (7) Internal plexiform layer, (8) Ganglion cells layer, (9) Optic nerve fiber laver, (10) Inner limiting membrane. H and E10x.

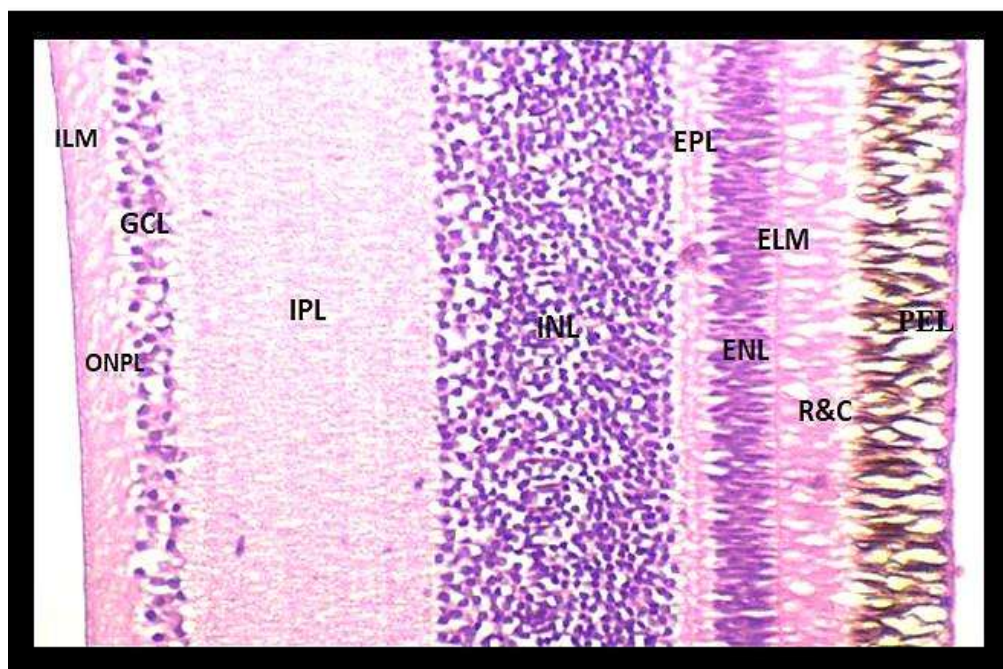


Figure (6) : Histological section Showing the layers of the retina in Iraqi blacked partridge *Francolinus francolinus* : Pigmented epitheliuml layer(PEL), Rod and cones layer(R&C) , External limiting membrane(ELM), External nuclear layer(ENL), External plexiform layer(EPL), Internal nuclear layer(INL), Internal plexiform layer(IPL), Ganglion cells layer (GCL) , Optic nerve fiber layer(ONPL), Inner limiting membrane (ILM) H and E 40x

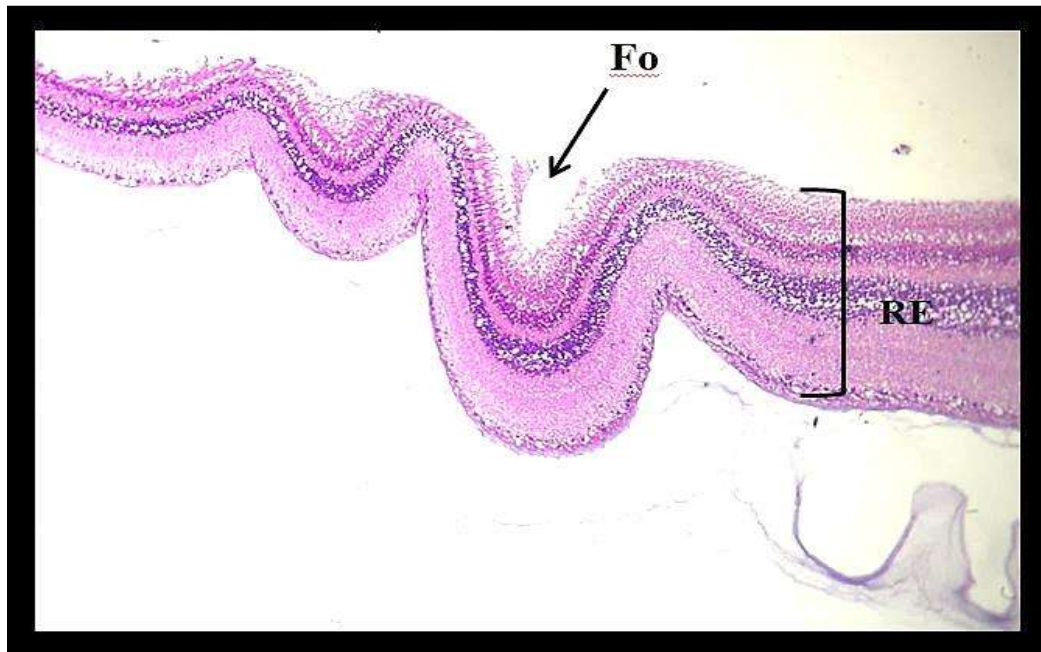


Figure (7) : Histological section showing the layers of the retina (RE) in Iraqi blacked partridge *Francolinus francolinus* , Fovea (FO). H and E 10x.

Discussion

The current study's findings demonstrated that the vascular layer in the eye of the *Francolinus francolinus* represents the middle layer, which lies between the fibrous layer and the retina layer , it appears to be composed of three main parts , namely : the first choroid , the second ciliary body, and the third iris. This result is structurally similar in other vertebrates as studied AlFartwisy in *Hemidactylus flaviviridis* and Al-Kelaby *et al*, in *Anas Platyrhynchus* [10].

Choroid

The study results explained that the choroid layer appears more vascular and consists of several layers including ,Epichoroid lamina, choriocapillary layer and Bruch's membrane. The Epichoroidal layer appears to be composed of thin collagen fibers, melanocytes , elastic fibers and fibroblast .The next layer is called choriocapillary layer and it is composed of many blood vessels and connective tissue between these vessels contains melanocytes. The choroid layer is separated from the retinal pigment epithelium by a thin membrane called Bruchs memberane, which lies below the choriocapillary layer.This result was consistent with the results of studies [11], [12]. The function of the choroid is to supply the retina with oxygen and nutrients and dissiplate excess heat [13].

Ciliary body

The study result showed that the ciliary body, which was attached anteriorly to the iris, served as the choroid's anterior support structure, It has a large surface area and several thick folds. This result is consistent with Ali and Mirhish, in Iraqi geese *Anser anser* [14]. The ciliary body encompassed the stroma, epithelium, and smooth muscles fibers This result is agree with [10], [15]. The nonpigmented innermost section of the epithelium. A pigmented outer ciliary epithelium connected to the pigmented retinal epithelium.The stroma is ahighly ,vascularized ,loose connective tissue layer, situated between the ciliary muscle and the epithelial layer ,directly continous with iris stroma anteriorly and choroid posteriorly, it contains blood vessels ,fibroblasts ,and pigmented cells . This results is similar to a study Al-Kelaby, in *Anas Platyrhynchus* [10]. The ciliary body contains a smooth muscle fibers that play an important role in adapting visin . this results agree with Ali and Mirhish, in Iraqi geese *Anser anser* [14], while the study results showed Evans and Martin in birds Cormorant *Phalacrocorax species* that the posterior muscular fibers were larger , whereas the frontal muscular fibers were larger in Owls [16],

Hawks, and Water Birds. The functions of the ciliary muscle, which include shifting the ciliary body anteriorly as part of the lenticular accommodating mechanism and modifying the corneal curvature for corneal accommodation, have been recently proposed [13], [17].

Iris

The iris occupies the anterior part of the vascular layer and surrounds the pupil, it is considered the last part of this layer and appears to be elongated in shape. The anterior surface comprises of layer of fibroblasts and melanocytes. The stroma comprised blood arteries, smooth muscle fibers, and fibroblasts derived from loose connective tissue. The iris's posterior surface is covered in a two-layered epithelium that is strongly melanin-filled and continuous with the ciliary processes. This results in consistent with a study Abd and Abd-Al Majeed, in conrake *crex crex* and Abd in *Pica Pica* [18]. The iris also acts a barrier in front of the lens and contributes to the adaptation of the pupil, which is located in its center [19]. Pigmented cells contain pigments such as carotene, purine and pteridine, which give the iris color and prevent the passage of ultraviolet rays, which cause damage to the retina [13]. The light entering the eye is controlled by the contraction and relaxation of the iris muscle [20].

Retina

The current study clarified that the retina is the innermost layer of the eyeball. The retina consisted of two parts: a nonsensory region and a sensory section. This nonsensory region of the retina begins at the iris after passing via the ciliary body. The retina's ten layers made up its sensory portion: first layer is the epithelium and it is called retinal pigmented, second layer is rods and cones, the third layer is the membrane which is called external limiting, the fourth layer is external nuclear, the fifth layer is called external plexiform, the sixth layer, which is called internal nuclear, and seventh in the arrangement of the layers of the retina is called internal inner plexiform, the eighth layer of the retina is ganglion cell, the ninth layer is called nerve fibers, finally inner limiting membrane. This result in vertebrates is consistent with the results number of the studies [21], [22], [23], [24]. The results of the current study showed that the pigment cell layer is the outer layer and represents the first layer of the retina, it consist of cuboidal epithelial cells arranged in a single row with a prominent nucleus and which is based on the basement membrane, numerous cytoplasm extensions extend between the visual cells and are characterized by containing pigment granules that give them a dark color. These observations were similar as described by Al-Tae and Al-Tae in Brown Falcon, Abd and Abd-Al Majeed, in Corncrake *crex crex* [18], [25]. While in chickens the pigment epithelial layer appeared long and narrow [26]. Pigmented cells generate the pigment melanin, which is found in the pigment epithelium of the retina and provides direct defense against UV radiation damage [27]. The amount of Pigmented cells varies according on environmental factors including exposure to sunshine [28]. There is a layer of rods and cones that are sensitive to light and adjacent to the pigmented epithelial cells. This results agree with Al-Rubae[29] in falcon and Ali[24] in pigeon and duck. Each one has an inner portion and an outside component that overlaps and extends the pigmented epithelial cells. The outer part of the cones is conical in shape and wider, while the rods appear thin and cylindrical in shape. This results is consistent with Abid in *Pica pica* [30], Al-Tae and Al-Tae in Brown Falcon [25]. This distinguishes birds with diurnal activity [19]. As for nocturnal animals, the layer of visual cells contains of long, thin rods and there are no cones [2]. External limiting membrane is lighter in color and the separation between the layer of rods and cones from the other layer is considered to be outer nuclear layer. This results is similar with [10], [14]. The external nuclear layer contains the elongated nuclei of rods and cones, number of rows of cells is between 2 – 3. This results is agree with [31]. While the number of rows in Iraqi spiny-tailed lizard 1-2, and white-breasted kingfisher 3-4 [30]. The number of different rows indicated variation in optical cells in terms of density [8]. The thin layer known as the external plexiform layer served as a barrier between the inner and outer nuclear layers, the dendrites of both bipolar and horizontal cells entwine with the axons of photoreceptor (rod and cone) in the outer plexiform layer. This result is agree with [18], [32]. The internal nuclear layer is characterized by containing a large number of cells that are tightly packed and diverse, and composed of horizontal cells, bipolar cells, number of rows shown from 14-16 in *Francolinus francolinus*. This result agree with [10], [25]. The results show that innermost layer of the inner plexiform layer is thicker than outermost plexiform layer, and consists of interconnected axons of amacrine and bipolar cells with dendrites of

the ganglion cells [33]. The ganglion layer is the deepest cellular layer in the retina and consists of two rows of cells, its cells appear large in size with a clear nucleus. This results is agree with [21], [25] while he explained Abid in *pica pica* and *Rattus norvegicus* that the layer consists of a single rows of cell [30]. Axons congregate in ganglion cells to form the layer of nerve fiber, which thickens as it descends to form the nerve that leaves the eye and travels to the brain. inner limiting membrane it appears as a very thin membrane that separates the retina from the vitreous fluid. This is consistent with the result [20], [30]. The study results showed the presence of a concave area in the dorsal region of the retina called the fovea, which is important in providing high-resolution vision and image clarity, and contains a large number of photoreceptors. This results is agree with [32].

Conclusion

The vascular layer in the eye of the represents the middle layer, which lies between the fibrous layer and the retina layer, it appears to be composed of three main parts, namely: the first choroid, the second ciliary body, and the third iris. the choroid layer appears more vascular and consists of several layers including, Epichoroid lamina, choriocapillary layer and Bruch's membrane. The ciliary body encompassed the stroma, epithelium, and smooth muscles fibers. The ciliary epithelium consisted of nonpigmented innermost and a pigmented outer ciliary epithelium. The stroma comprised blood arteries, smooth muscle fibers, and fibroblasts derived from loose connective tissue. The iris's posterior surface is covered in a two-layered epithelium that is strongly melanin-filled and continuous with the ciliary processes. The retina consisted of two parts, A nonsensory region and a sensory section.

REFERENCES

- [1] R. Ofri, *Retina In Slatter's fundamentals of Veterinary Ophthalmology*, 4th ed. St. Louis Missouri, 2008.
- [2] M. A. Gali and H. A. M. Dauod, *Comparative Anatomy of Chordates*, 2nd ed. Dar Al – Doctor the Administrative and Economic Sciences, 2014.
- [3] R. Martin and G. Katzir, "Visual fields in short-toed eagles, *Circaetus gallicus* (Accipitridae), and the function of binocularity in birds," *Brain, Behaviour and Evolution*, vol. 53, no. 2, pp. 55–66, 1999.
- [4] L. Williams and E. Flach, "Symbplepharon with aberrant protrusion of the nictitating membrane in the snowy owl (*Nyctea scandiaca*)," *Vet. Ophthalmol.*, vol. 6, no. 1, pp. 11–13, 2003.
- [5] S. Brooke M. de L.; Hanley and S. B. Laughlin, "The scaling of eye size with body mass in birds," *Proceeding of the Royal Society Biological Sciences*, vol. 266, pp. 405–412, 1999.
- [6] K. V Kardong, *Vertebrates Comparative Anatomy, Function, Evolution*, 6th ed. McGraw – Hill, 2012.
- [7] M. A. Gali and S. A. Abid, "A comparative study to determine the nature of the eye lens protein in the two types of birds Iraqi," *Baghdad Sci J.*, vol. 12, no. 2, pp. 238–241, 2015.
- [8] P. M. Treuting and S. M. Dintzis, *Comparative Anatomy and Histology A Mouse and Human Atlas*, 1st ed. Elsevier Inc., 2012.
- [9] J. D. Bancroft and A. Stevens, *Theory and practice of histological techniques*, 2nd ed. Churchill Living Stone Edinburgh, 2013.
- [10] A. K. Z. S. M. Al-Kelaby W.J.A. and H. A. Alhussaniy, "Histological and Histochemical Studies of the Eye Structure of *Anas platyrhynchos* (Mallard) Duck Species," *Indian Vet. J.*, vol. 100, no. 3, pp. 7–15, 2023.
- [11] T. L. B. C. D. R. R. P. D. B. P. M. B. A. F.-J. E. Tyrrell L.P., "A novel cellular structure in the retina of insectivorous birds," *Sci Rep*, vol. 9, 2019.
- [12] L. C. Junqueira and J. Carneiro, *Basic histology text and atlas*, 11th ed. McGraw-Hill, 2005.
- [13] R. M. ; T. J. Bayon A.; Almela, "Avian ophthalmology," *Ophthalmol.*, vol. 17, no. 3, pp. 253–265, 2007.
- [14] M. A. Ali and S. M. Mirhish, "Histological Study of ciliary body and retina of eye in Iraqi geese (*Anser anser*)," *Kufa Journal For Veterinary Medical Sciences*, vol. 10, no. 2, pp. 74–81, 2019.
- [15] V. P. Eroschenko, *Atlas of Histology, with functional correlation*, 10th edition. Lippincott Williams and Wilkins, 2005.

- [16] Evans H.D. and G. R. Martin, *Handbook of Avian Anatomy: Nomina Anatomica Avium*. Nuttall Ornithological Club, 1993.
- [17] N. A. Shehan, "Anatomical and histological study of eye in local chickens (*Gallus domesticus*) at Basrah city," *ALQadisiya Journal of Vet. Med. Sci.*, vol. 11, no. 2, pp. 53–59, 2012.
- [18] A. A. Abd and S. A. Abd Al Majeed, "Anatomical, Histological Study Eye of the Bird Corncrake *crex crex*," *Rafidain Journal of Science*, vol. 21, no. 4, pp. 1–26, 2010.
- [19] K. E. Jones M. P.; Pierce and D. Ward, "Avian vision: A review of form and function with special consideration to birds of prey," *J. Exotic. Pet. Medicine*, vol. 16, no. 2, pp. 69–87, 2007.
- [20] A. L. Mescher, *Junqueira's basic histology text and atlas*, 13th ed. McGraw Hill, 2013.
- [21] S. M. Al-Robaae S.J.M.; Mirhish and J. M. Rajab, "Histological Studies on the Retina of the Falcon "S Eye Ball (*Circus Cyaneus* C.) Under Light and Electron Microscopy," *The Iraqi Journal of Veterinary Medicine*, vol. 36, no. 2, pp. 83–92, 2012.
- [22] E. Kh. H. Al-Khalefa, "Anatomical, histological and histochemical study of the eye of snake *Hemorrhoidsravergieri*," *Iraqi Journal of Veterinary Sciences*, vol. 28, no. 1, pp. 25–36, 2014.
- [23] T. R. Alhasson F.A; Mhalhal and M. Abbas, "Histological and Histomorphometric Study of Retina in Pigeon and *Sturnus Vulgaris*," *Annals of R.S.C.B.*, vol. 25, no. 6, pp. 19674–19679, 2021.
- [24] M. A. Ali, "HISTOLOGICAL AND HISTOMORPHOMETRIC STUDY OF RETINA IN PIGEON AND DUCK," *Bas.J.Vet.Res*, vol. 15, no. 2, pp. 260–266, 2016.
- [25] A. A. Al-Tae and R. A. M. Al-Tae, "Histological Study of Dorsal Retina in Eye of Brown Falcon, Iraq," *Annals of R.S.C.B.*, vol. 27, no. 1, pp. 310–316, 2023.
- [26] W. J. Bacha and L. M. Bacha, *Color Atlas of Veterinary Histology*, 2nd Ed. Lippincott Williams and Wilkins, 2000.
- [27] D. E. Lin J. Y.; Fisher, "Melanocyte biology and skin pigmentation," *Nature*, vol. 445, pp. 843–850, 2007.
- [28] H. A. ; S. M. G. ; M. M. E. A. Miot L. D. B.; Miot, "Fisiopatologia do melasma," *Anais Brasileiro de Dermatologia*, vol. 84, no. 6, pp. 623–635, 2009.
- [29] S. J. Al-Rubae, "Morphological and histological study of eye ball in falcon," 2010.
- [30] Sh. A. Abid, "A COMPARATIVE HISTOLOGICAL STUDY OF THE RETINA IN TWO SPECIES OF IRAQI VERTEBRATES," *The Iraqi Journal of Agricultural Sciences*, vol. 48, no. 6, pp. 1573–1581, 2017.
- [31] Sh. A. A. Al-jaboori, "Comparative Morphological and Histological Study of the Eye in two Species of Iraqi birds (*Falco tinnunculus* L. and *Streptopelia decaocto* F)," 2014.
- [32] R. S. H. Hussian and A. A. Al-Tae, "Histological study of falcons Retina eye and optic nerve," *HIV Nursing*, vol. 23, no. 2, pp. 412–416, 2023.
- [33] A. M. T. A. Al-hamadany, "Comparative Anatomical, Histological with Developmental Study at Light and Electron Microscopic Level of Eye and Alimentary Canal for three Species of Birds which Differ in Nutrient Nature," Ph.D. Dissertation, College of Education, Mosul University, 2012.