Anatomical and histological study of eye in local chickens (*Gallus domesticus*) at Basrah city

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Abstract

Chickens (*Gallus domesticus*) present several advantages as an animal model to study the anatomical and histological field of eye, For instance, they have large eyes that grow surprisingly fast (100 µm per day), exhibit good optics, and powerful accommodation . So, under this study a total of (20) male local chickens were studied. Then, for histological study the other (10) chicken was cut off their eyes and fixed directly with 10% formalin.The weight, length and width of eye, cornea and iris were recorded and the mean and S. D. was founded: 16.5771, 1.993; 18.3, 0.8331; 18.3, 0.823 for weight (gr.), length and width of eye (mm) respectively. While, the length and width (mm) of cornea: 8.300, 0.483 and 8.400, 0.516 respectively, and in iris: 5.42, 0.516 and 5.42, 0.421.The anatomical and histological section showed a clear layers and cells, the sclera with clear fibroblast, collagen fibers and elastic fibers, The layers of retina were noticed with pigmented epithelial layer, rods and cones, external laminated layer, external nuclear layer, external plexus layer, inner nuclear layer, inner plexus layer, basal cell layer, nerve fiber layer, inner laminate layer. the ciliary process consist of smooth muscles, ciliary process, supercillary process, pigmented ciliary epithelia.This study recorded as a first one in Basrah city.

Key Words: Local chickens, eye, cornea, sclera, retina, iris,

Introduction

The eye of birds most closely resembles that of the reptiles. Also, unlike the mammalian eye, it is not spherical, and the flatter shape enables more of its visual field to be in focus. Furthermore, a circle of bony plates, the sclerotic ring, surrounding the eye and holds it rigid, but an improvement over the reptilian eye, also found in mammals, the lens is pushed further forward, increasing the size of the image on the retina (1). Most birds cannot move their eyes, although there are exceptions, such as the Great Cormorant (2). Birds with eyes on the sides of their heads have a wide visual field, useful for detecting predators, while those with eyes on the front of their heads, such as owls, have binocular vision and can estimate distances when hunting (3).(4) reported that the eyelids of a bird are not used in blinking. Instead the eye is lubricated by the nictitating membrane, a third concealed eyelid that sweeps horizontally across the eye like a windscreen wiper. While, (5)focused that the nictitating membrane also covers the eye and acts as a contact lens in many aquatic birds when they are under water.Eye is also cleaned by tear secretions from the lacramial gland and protected by an oily substance from the Harderian gland which coats the cornea and prevents dryness. The eye of a bird is larger compared to the size of the animal than for any other group of animals, although much of it is concealed in its skull. The Ostrich has the largest eye of any land vertebrate, with an axial length of 50 mm (2 in), twice that of the human eye (1).Bird eye size is broadly related to body mass, (5) studied of five orders (parrots, pigeons, petrels, raptors and owls) and showed that eye mass is proportional to body mass, but as expected from their habits and visual ecology, raptors and owls have relatively large eyes for their body mass.The outer layer of the eye consists of the transparent cornea at the front, and two layers of sclera – a tough white collagen fiber layer which surrounds the rest of the eye for supports and protects the eye as a whole, the eye is divided internally by the lens into two main chambers: the anterior and the posterior. The anterior chamber is filled with a watery fluid called the aqueous humour, and the posterior chamber contains the vitreous humour, a clear jelly-like substance. The

lens is a transparent convex or 'lens' shaped body with a harder outer layer and a softer inner layer. It focuses the light on the retina. The shape of the lens can be altered by ciliary process which are directly attached to lens capsule by means of the zonular fibres. In addition to these muscles, some birds also have a second set, Crampton's muscles, that can change the shape of the cornea, thus giving birds a greater range of accommodation than is possible for mammals. This accommodation can be rapid in some diving water birds such as in the mergansers. The iris is a colored muscularly operated diaphragm in front of the lens which controls the amount of light entering the eye. At the centre of the iris is the pupil, the variable circular opening through which the light passes into the eye (6, 7).Towards the centre of the retina is the fovea which has a greater density of receptors and is the area of greatest forward visual acuity, i.e. sharpest, clearest detection of objects. In 54% of birds, including birds of prey, kingfishers, hummingbirds and swallows, there is second fovea for enhanced sideways viewing. The optic nerve is a bundle of nerve fibers which carry messages from the eye to the relevant parts of the brain and vice-versa (6).The aim of this study was to investigate the anatomical and histological view of eye and eye layers in local chickens as a first study in Basrah city.

Materials and Methods

- **Collecting Samples:**

A total of (20) males of local chicken were brought out from local market in Basrah city after examined as negative from any infects or diseases.

- **Anatomical Part:**

Each one of the sample were washed in clean water many times, then (10) of them were injection with 0.9% normal saline by venues after that injection with 10% formalin, then, left in clean glass cans for 48 hour. After that each eyes from each samples were cut carefully and the measurement for each eye was done, also, the weight was noticed.

- **Histological Part:**

For histological study the other (10) chicken was cut off their eyes and fixed directly with 10% formalin, then, a procedure by (8) were done with eosin and haematoxyline stain.

Results

In table (1) the mean and S. D. of length, width and weight of eye, cornea and iris.

Part of Eye	Weight/ gr.		Length/ mm.		Width/ mm.	
	Mean	S. D.	Mean	S. D.	Mean	S. D.
Eye	16.5771	1.993	18.3	0.8331	18.3	0.823
Cornea			8.300	0.483	8.400	0.516
Iris			5.42	0.516	5.42	0.421

The anatomical results shows a sclera, cornea and iris (fig. 1), while, in (fig. 2) founded the anterior chamber, choroid, posterior chamber, sclera, retina, lens, cornea and ciliary process. The choroid, retina, lens, sclera and cornea founded clearly in (fig. 3)

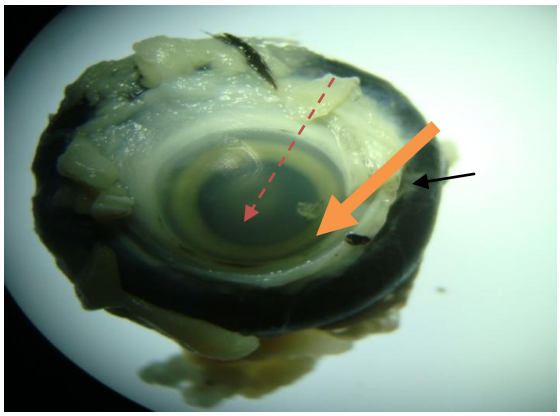


Fig (1): Eye of chicken with sclera ←, cornea ↙ and iris ⇠

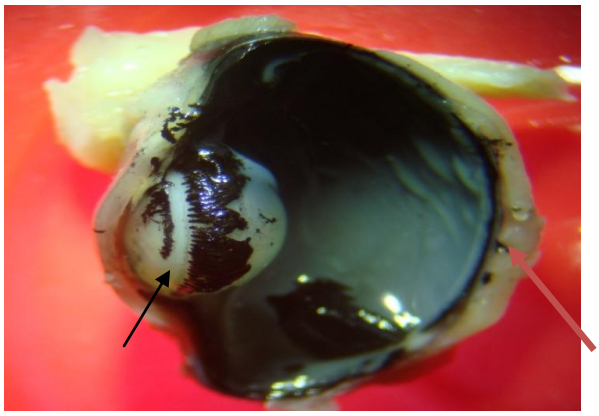


Fig (2): Anterior ↗ and posterior ↘ chamber of chicken eye

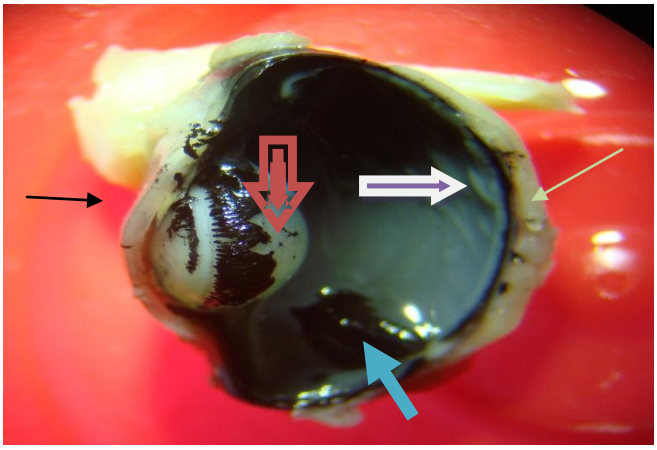
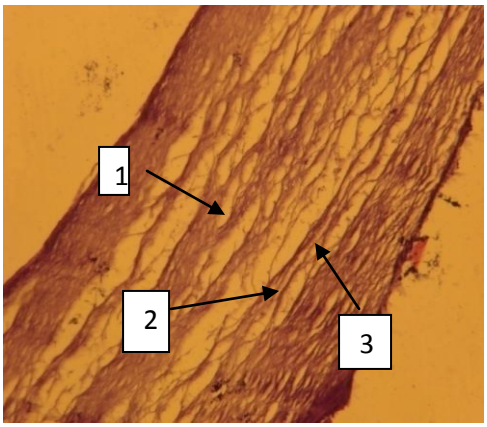
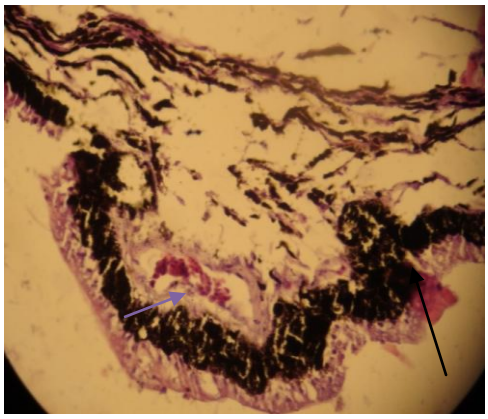


Fig (3): choroid ↖, retina ⇒, lens ⇓, sclera ↙ and cornea → of chicken eye.

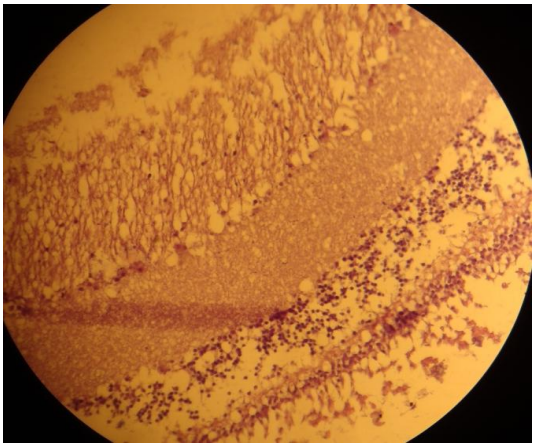
The histological results shows; the sclera with clear fibroblast, collagen fibers and elastic fibers (fig. 4), while, in (fig. 5) founded the sclera and choroid.The layers of retina were noticed in consisted with; pigmented epithelial layer, rods and cones, external laminated layer, external nuclear layer, external plexus layer, inner nuclear layer, inner plexus layer, basal cell layer, nerve fiber layer, inner laminate layer (figs. 6, 7). The retina is a relatively smooth curved multi-layered structure containing the photoreceptor cells and cone cells with the associated neurons and blood vessels. The density of the photoreceptors is critical in determining the maximum attainable visual acuity.



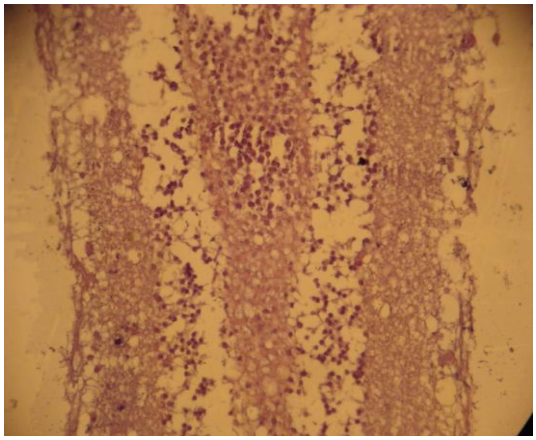
(Fig: 4): The sclera of chicken eye. 1- pigment cells, 2- collagen fibers, 3- elastic fibers. E & H. (40X).



(Fig: 5): The sclera and choroid of chicken eye. E & H. (40 X).



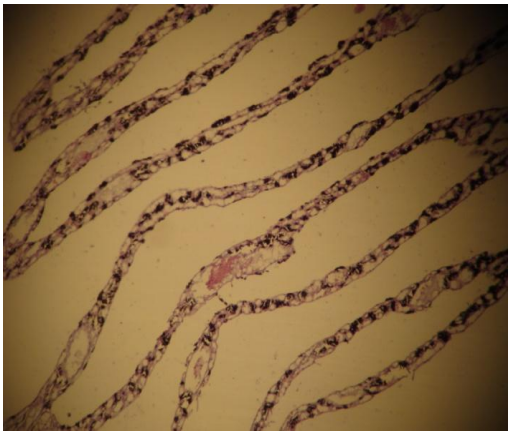
(Fig: 6): The retina of chicken eye. E & H. (40 X).



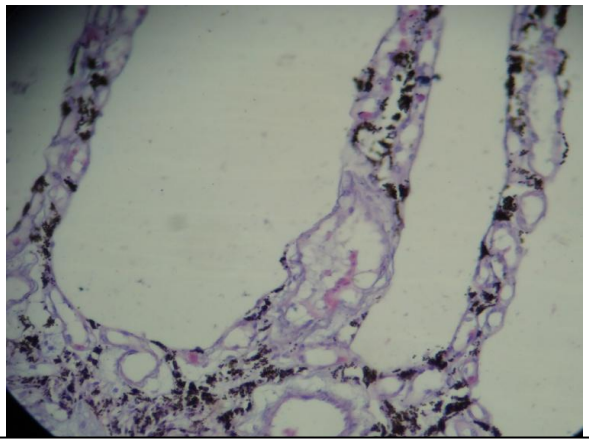
(Fig: 7): The retina of chicken eye. E & H. (40 X).

The ciliary body clear in (figs.8, 9, 10), which consist of smooth muscles, ciliary process, supercillary process, pigmented ciliary epithelia. The ciliary musculature of the chicken eye founded under this study was composed of two major muscle groups within which five arrangements of muscle fibers have been identified. The anatomy of the ciliary muscle is consistent with the recently proposed functions of altering the corneal curvature for corneal accommodation and moving the ciliary body anteriorly as a part of the lenticular accommodative mechanism.

(Fig: 8):The ciliary process and lens of chicken eye. E & H. (40 X).



(Fig: 9): The normal pectin of chicken eye. E & H. (40 X).



(Fig: 10): The normal pectin of chicken eye. E & H. (40 X).

Discussion

Eyes may be even more important to birds than to human. One indication of this is that bird eyes are much larger, relative to total face area, than human eyes (9).The ciliary region of the chicken eye is asymmetric through the horizontal plane, with the distance from the limbus to the equator of the eye being greatest temporally. This asymmetry is reflected in the relative development of the ciliary musculature and The ciliary muscle also may serve in the regulation of aqueous dynamics within the eye. This result agree with (10).The current study revealed that the main structures of the bird eye are similar to those of other vertebrates.(11) Reported that rods are more sensitive to light, but give no color information, whereas the less sensitive cones

enable color vision. In diurnal birds, 80% of the receptors may be cones (90% in some swifts) whereas nocturnal owls have almost all rods. As with other vertebrates except placental mammals, some of the cones may be double structures. These can amount to 50% of all cones in some species. The different ocular structures of the chicken (mainly the cornea and the retina) have been examined and imaged through several techniques by different studies at the world such as electron microscopy (12), X-ray imaging (13), OCT (14) and fluorescence microscopy (15). (16) reported that Chickens have served as animal models for the study of the cornea wound healing after refractive surgery treatments, such as LASIK, LASEK or PRK. Eye growth responds readily to alterations of visual experience, like treatments with lenses (17), or diffusers (18). The chicken reaches maturity in less than a year (19) and it can be easily bred and maintained in the laboratory from the day of hatching.In conclusion the current study showed an anatomical and histological view of local chickens eyes for done further future study as detection some eyes diseases or study the rezones for blindness in birds.

References

1. Wikipedia, (2011). Bird Vision. A free incyclopidia.
2. White, Craig R.; Day, N.; Butler, P.J.; Martin, G.R.; Bennett, Peter (2007). "Vision and foraging in cormorants: more like herons than hawks?" (PDF). *PLoS ONE* 2 (7): e639.doi:10.1371/ journal. pone. 0000639. PMC 1919429. PMID 17653266. http://eprints.bham.ac.uk/55/1/martin.pdf.
3. Martin, Graham R. and Katzir, G. (1999). "Visual fields in short-toed eagles, *Circaetus gallicus* (Accipitridae), and the function of binocularity in birds". *Brain, Behaviour and Evolution* 53 (2): 55–66.
4. Williams, David L. and Flach, E. (2003). "Symblepharon with aberrant protrusion of the nictitating membrane in the snowy owl (*Nyctea scandiaca*)" (PDF). *Veterinary Ophthalmology* 6 (1): 11–13. http://www.davidlwilliams.org.uk/resources/file0016.pdf.
5. Brooke, M. de L.; Hanley, S. and Laughlin, S. B. (1999). The scaling of eye size with body mass in birds. *Proceeding of the Royal Society Biological Sciences* 266: 405–412.
6. Sinclair, S. (1985). *How Animals See: Other Visions of Our World*. Beckenham, Kent: Croom Helm.
7. Sivak, J. G. (2004). "Through the Lens Clearly: Phylogeny and Development". *Invest. Ophthalmol. Vis. Sci.* 45 (3): 740–747.
8. Luna, L. G. (1968). Manual of histological staining method of armed forces institute of pathology. 3rd. Ed., Mc- Graw- Hill Book Co., New York.
9. Home Page. (2011). Birdes Menu.
10. Davis Buckner, G.; Wilkins, R. H. and Kastle, J. H. (1918). The normal growth of White Leghorn chickens., Am. J. Physiol. 47, 393–398.
11. Nalbach Hans-O.; Wolf, O., Friedericke and Remy M. (1993).Exploring the image., Ziegler & Bischof ., 26–28
12. Trelstad R. L. and Coulombre, A. J. (1971). Morphogenesis of the collagenous stroma in the chick cornea," J. Cell Biol. 50(3), 840–858.
13. Boote, C.; Hayes, S.; Jones, S.; Quantock, A. J.; Hocking, P. M.; Inglehearn, C. F.; Ali, M. and Meek, K. M. (2008). Collagen organization in the chicken cornea

and structural alterations in the retinopathy, globe enlarged (rge) phenotype--an X-ray diffraction study., J. Struct. Biol. 161(1), 1–8.

14. Wolsley, C. J.; Saunders, K. J.; Silvestri, G. and Anderson, R. S. (2008). Investigation of changes in the myopic retina using multifocal electroretinograms, optical coherence tomography and peripheral resolution acuity., Vision Res. 48(14), 1554–1561.
15. Kim, S. Y.; Ondhia, N.; Vidgen, D.; Malaval, L.; Ringuette, M. and Kalnins, V. I. (1997). Spatiotemporal distribution of SPARC/osteonectin in developing and mature chicken retina," Exp. Eye Res. 65(5), 681–689.
16. Mar, S.; Martinez-Garcia, M. C.; Blanco-Mezquita, J. T.; Torres, R. M. and Merayo-Lloves, J. (2009). Measurement of correlation between transmission and scattering during wound healing in hen corneas," J. Mod. Opt. 56(8), 1014–1021.
17. Schaeffel, F.; Glasser, A. and Howland, H. C. (1988). Accommodation, refractive error and eye growth in chickens., Vision Res. 28(5), 639–657.
18. Wallman J. and Adams, J. I. (1987). Developmental aspects of experimental myopia in chicks: susceptibility, recovery and relation to emmetropization., Vision Res. 27(7), 1139–1163.
19. Wildsoet C. F. and Pettigrew, J. D. (1988). Experimental myopia and anomalous eye growth-patterns unaffected by optic-nerve section in chickens: evidence for local-control of eye growth., Clin. Vis. Sci. 3, 99–107.

دراسة تشريحية ونسيجية لعين الدجاج المحلي في مدينة البصرة

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الخلاصة

يعد الدجاج من الحيوانات التي يسهل التعامل معها والتي تعد نموذجا لاجراء العديد من الدراسات، لما تمتلكه من صفات متمثلة بالنمو السريع (100 مايكرون/ اليوم) وعصب بصري جيد النمو. لذا جرت الدراسة الحالية للكشف تشريحيا ونسيجيا عن عين الدجاج، اذ فحص (20) ذكر من الدجاج المحلي، اما للدراسة النسيجية فقد اخذت (10) نماذج من الاعين وحفظت في الفورمالين 10% واجريت عليها الدراسة.تم اخذ الوزن، الطول والعرض لكل من كرة العين، القرنية والقزحية، حيث وجد ان معدل الوزن(غم) والانحراف المعياري لها: 16.5771، 1.993، 18.3، 0.8331، 18.3، 0.823 على التوالي. بينما، طول وعرض القرنية(مم) سجل معدلا وانحرافا معياريا: 8.300، 0.483، 8.400، 0.516على التوالي. اما القزحية فكانت 5.42، 0.516، 5.42، 0.421.اوضحت الدراسة النسيجية والتشريحية طبقات الخلايا واضحة: ففي الصلبة لوحظت الارومات الليفية، الياف الكولاجين، الالياف المطاطية. اما الشبكية فلوحظت فيها الطبقة الطلائية الصبغية، العصى والمخاريط، الصفيحة الخارجية، الطبقة النووية الخارجية، طبقة الظفيرة الخارجية، الطبقة النووية الداخلية، طبقة الظفيرة الداخلية، طبقة الخلايا القاعدية، طبقة الالياف العصبية، طبقة الصفيحة الداخلية. أما الجسم الهدبي فيتكون من العضلات الملساء، البروزات الهدبية العليا، الظهارة الصباغية الهدبية. تعد هذه الدراسة الاولى من نوعها في مدينة البصرة.