



Histological Characterization of the Retina and Pecten Oculi of Brown Pigeon (*Zenaida macroura*)

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Abstract

Original Research Article

Aim: The pecten oculi had important functional significances for retina nutrition. Objective: The present study intends to shed some light on few arterial and venous circulations which reached the eye, constructional histological formation of retina along with a pecten oculi in brown pigeon. **Material and methods:** Adult pigeon eyeballs were used for this study (anatomy of the retina and pecten oculi). The tissue was fixed in 10 % formalin and embedded. Conventional histological methods were used to examine the specimens. **Conclusion:** The pecten oculi consists of three parts - an optic disk-based base; fan-shaped pleats; and a bridge. The histological component of brown pigeon' pecten oculi are: pigment cells, vessels of blood and lymphatic vessels. Retina composed of 10 layers, the inner nuclear layer is the largest one as in other birds.

Keywords: retina, Pecten oculi, brown pigeon, *Zenaida macroura*.

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INTRODUCTION

The brown pigeon is belonging to a diurnal bird that is distributed around the world and is a member of the order Columbiformes family Columbidae genus *Phapitreron* [1]. The pecten oculi is: a thin, pigmented organ unique to a bird's eye providing the retina with oxygen and nourishment [19, 2]. It extends to the vitreous body from the retina [3]. There are three distinct anatomical forms of pecten oculi: pleated, vaned, and conical [4]. The avian pecten's histological structure is mostly composed of many capillaries, melanocytes, and connective tissue [5]. Pecten's role in the development of a blood-retinal barrier [6] and avascular retina [2] appears to be feeding. Birds that are nocturnal and those that are diurnal exhibit different numbers and sizes of folds in their pecten oculi [4]. Retina is an internal layer of the eyeball (nervous tunic) comprised of ten layers [7,8], The outer pigmented cuboidal epithelial cells layer and nine inner layers : inner nuclear layer includes bipolar neurons, (horizontal and an amacrine cells); inner plexiform layer comprised of dendrites of ganglion cells

with the bipolar neuron axons; layer of ganglion cell consists of ganglionic cells [9]; nerve fiber layer formed by axons of ganglion cells; and photoreceptor layer consist of rods and cones, outer limiting membrane, outer nuclear layer , and inner limiting membrane [10-12]. The current work was aimed to investigate the structure of retina and pecten oculi of brown pigeon.

MATERIALS AND METHODS

Samples:

In this study, the pigeon used as the model for diurnal birds. The anesthesia process involved the use of chloroform, followed by the precise removal of feathers using scissors. Access to the skull was gained by fracturing it with a cutter, after which the bones of skull were carefully removed [13]. The eye was then extracted from the orbit, cleaned, and placed in a petri dish on filter paper for storage [14].

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Histology:

The tissue samples were processed for histological staining. Tissue blocks were cut into 5µm thick sections and then stained with common stains (Mayer's Hematoxylin and Eosin) [15]. The stained sections were analyzed using a light microscope and the images were taken with an iPhone camera. The thickness of different retinal layers was measured using an ocular micrometer after calibration, and the corresponding images were captured.

Statistical Analysis:

The Statistical analysis was conducted using SPSS software version 23, employing the Analysis of Variance (ANOVA) and Dunck's test to assess significant differences.

RESULTS AND DISCUSSION

The research findings revealed that the pecten of pigeon with pleated shape folded to increase the surface area, which consistent with previous reports on other avian species [16]. Also our results agreed with [2] who study ducks, pigeons, turkeys, and starlings. In contrast, the ostrich's pecten was of the vaned shape with primary, secondary, and tertiary lamellae with variations included the pleats number, shape, size, and the thickness of the basal lamina of capillary among different species. These differences are attributed to the diurnal behavior and visual requirements of each species. Generally, diurnal birds have larger, more pleated pectens in comparison with nocturnal species that have small pecten (17). The intraocular "pecten oculi" of the brown pigeon resembles a delicate, slender, comb-like structure. Its free border and base, attached to the linear optic disc, extend freely into the vitreous body (Fig. 1A, B).

At the tip of the pecten oculi, there were shorter and narrower folds that terminated in a thicker, rounded structure called the bridge. The surface of the bridge displayed deep indentations and was composed of a few small capillaries lined by simple squamous endothelial cells, along with a network of polymorphic melanocytes intertwined with various blood vessels, which give it intense black coloration (enables it to absorb the heat of all radiation that falls on it). Erythrocytes were observed in the blood capillary lumen, consistent with the findings of [18].

In addition to lymphocytes, these lymphatic capillaries linked the vitreous membrane to the blood capillaries (Fig. 2C–D). This finding is consistent with previous studies on *Gallus domesticus* [19] and the results also indicate that the pigeon's retina is composed of ten layers (Fig. 2). Result showed that the second layer in retina consisting of rods and cones photoreceptors cells in pigeon this results agreed with [1,7-9].

Thickness of the retinal layers was (177.4 µm) (Fig. 3). Specifically, pigmented epithelial layer measured 5.4 µm, photoreceptor layer 26 µm, an outer limiting membrane 26 µm, an outer nuclear layer 13 µm, an outer plexiform layer 8.8 µm, an inner nuclear layer 38.5 µm, an inner plexiform layer 40.5 µm, ganglionic layer 8.8 µm, an optic nerve fiber layer 6.9 µm, and an inner limiting membrane measured 3.5 µm (Fig. 1 and 3). Notably, this data presents a contrast to [20] findings concerning ducks and pigeons. In summary, the histological examination of the pecten oculi in brown pigeons revealed that the retina comprises ten layers and has a pleated structure of pecten. These findings are consistent with those of the majority of other diurnal bird species.

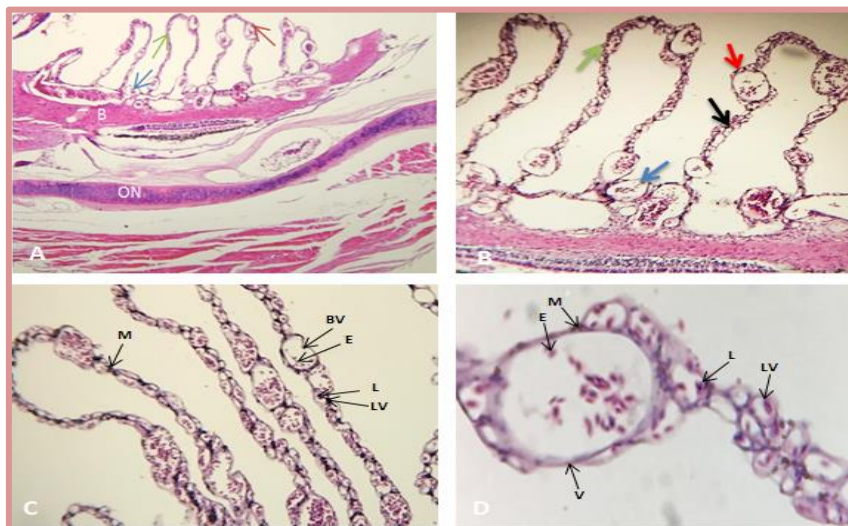


Figure (1): Light micrograph of the pecten oculi in a brown pigeon is depicted, with magnifications at X4 and X10, highlighting the pecten fold (indicated by a green arrow), blood vessels (marked with red arrows), optic nerve (labeled as ON), and base (labeled as A and B). The micrograph also shows erythrocytes (E), melanocytes (M), pecten oculi at X10 (C), lymphocytes (L), and lymph vessels (v). At a higher magnification of X40, the dark coloring of the pecten oculi is attributed to a high concentration of melanocytes. This observation was made using the Hematoxylin and Eosin staining method

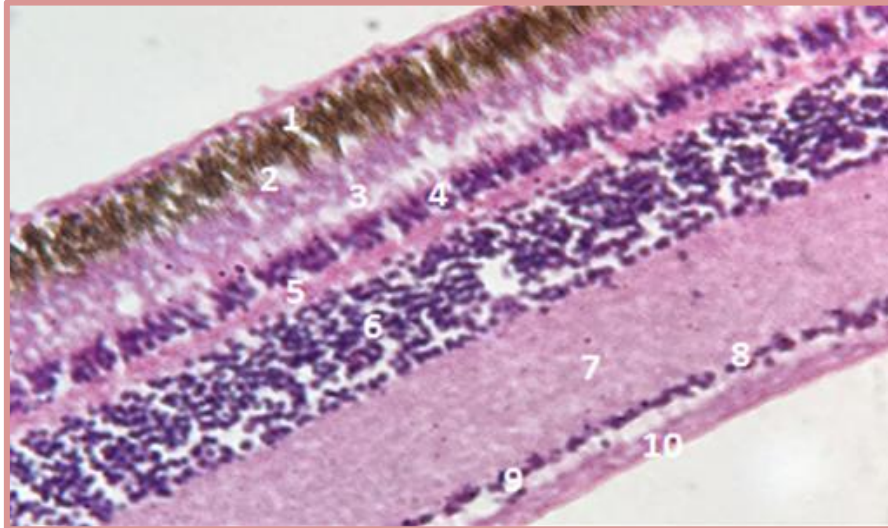


Figure (2): A longitudinal section of a brown pigeon's retina stained with hematoxylin-eosin reveals distinct layers including the epithelial pigment layer, optic cell layer, outer limiting epithelium, outer nuclear layer, outer plexiform layer, inner nuclear layer, inner plexiform layer, ganglion cell layer, optic nerve fiber layer, and inner limiting membrane

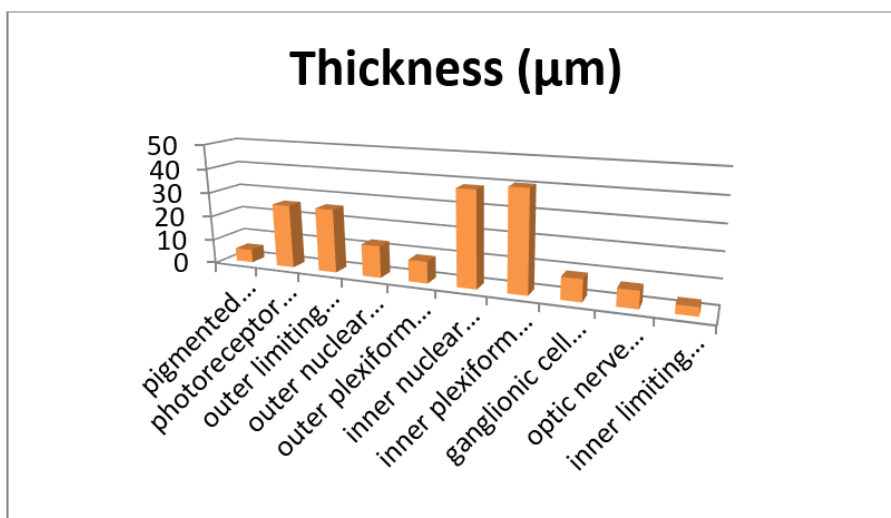


Figure (3): Thickness of the retinal layers (µm) in eye of brown pigeon

CONCLUSIONS

In summary, the histological examination of the pecten oculi in brown pigeons revealed that the retina comprises ten layers and has a pleated structure of pecten. These findings are consistent with those of the majority of other diurnal bird species.

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