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RESEARCH ARTICLE

ADAPTATION OF EYE OF THE EGYPTIAN AGAMA "*TRAPELUS MUTABILIS*" ACCORDING TO ITS ACTIVITY PATTERN

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ABSTRACT

The present study gives brief discussion about some structure of the eye of the Egyptian agama, *Trapelus mutabilis*, according to its diurnal activity. One of necessary components of the eye responsible for focusing the light on surface of the retina is the lens and cornea. The Egyptian agama possess spherical lens with a biconvex surface, consists of single layer of simple cuboidal epithelial cells anterior to the subcapsular cavity and capsulated by a thin cellular capsule. The cornea of the Egyptian agama is a transparent thin-walled curved structure that covers front of the eye. Histologically, cornea is formed of five layers: epithelium, bowman's layer, stroma, Descemet's membrane, and endothelium. The inner surface of eyeball is lining by retina, which contains some projections with small pits and a wide single fovea. Retinal layers represented by retinal pigmented layer, photoreceptor layer, cellular layers, and neural one. Photoreceptor layer of retina contains both single and double cones. The conus papillaris is a simple cone-shaped projection, heavily pigmented, and originating on top of the optic nerve that protrudes from retina into the vitreous chamber. The surface of conus papillaris has more projections with pits. Histologically, conus papillaris consists of blood vessels and many black pigment granules. The present study concluded that the lens and the transparent cornea with its curved appearance, and the cone photoreceptors only of the eye retina reflecting their adaptation to the diurnal activity pattern of the Egyptian agama.

INTRODUCTION

Most vertebrates have eyes that look different depending on how active they are. The large cornea in comparison to the size of the eye is an adaptation for increased visual sensitivity in nocturnal vertebrates (scotopic vertebrates). Moreover, the scotopic vertebrates, their retinae contain large number of rods to increase the ability of vision in dim light. Conversely, diurnal vertebrates (photopic) have large number of cones and their cornea is small relative to eye size that increase the visual acuity of diurnal vertebrates[1]. In terrestrial vertebrates, the cornea does most of the focusing and the lens only refines the image to bring it into clear focus on the retina, while the cornea does relatively little to focusing in aquatic vertebrates. Water and the cornea have nearly the same refractive indices. Therefore, aquatic vertebrate lenses refract most of the light through variations in lens location within eye[2,3]. Pigatto *et al.*[4] used scanning electron microscopy to study the morphometry of the endothelium of cornea of *Caiman yacare*. El-Bakry[5] referred to the structure of cornea in some reptiles living in various environments. Akhtar *et al.*[6] studied the adaptation of the dhub lizard, *Uromastyx*, to a desert environment *via* explaining the ultrastructure features of the cornea by using three-dimensional transmission electron tomography

The basic structure of retina is similar in vertebrate. However, the size, shape, number, and arrangement of the photoreceptor cells and the other retinal neurons varies between vertebrate groups. These variations reflect habits and habitats of various groups[7]. Vertebrate visual cells are classified into rods or cones, associated with scotopic or photopic vision, respectively[8]. Retinal sensitivity is increased by foveae. Reptiles have one fovea or two foveae per eye; they are shallow in some species and deep in others[9]. Pure-cone retinae appear to be common in lizards including iguanids, chameleons, agamids, scincids, lacertids, anguids, pygopodids, and varanids, all of which lack rods and have centrally located foveae[7,10-11]. Röll[7,8] studied the effect of gecko vision-retinal organization, fovea on binocular vision, and adaptation of Bouton’s skink retina and fovea to ecological constraints. Sillman *et al.*[12] and Khattab *et al.*[13] pointed out to the structure of retinal photoreceptors and visual pigments in the *Boa constrictor imperator* and in some reptiles, respectively. Barbour *et al.*[14] studied the retinal characteristics of the ornate dragon lizard, *Ctenophorus ornatus*. Hart *et al.*[15] studied the specialization of photoreceptor types, visual pigments, and topography in the retina of hydrophilic sea snakes. Gamble *et al.*[16] studied the advanced of diurnality in geckos. Williams[17] studied the capacity the regenerating reptile retinas to restoring retinal ganglion cell function. Karl *et al.*[18] also studied the retinal adaptation to dim light vision in spectacled caimans, *Caiman crocodilus fuscus*.

In addition, retina of reptiles is a vascular structure; its nourishment is mainly supplied from a highly vascularized body known as conus papillaris[19]. The conus papillaris, which protrudes from the optic nerve head into the vitreous chamber and is similar to the avian pecten oculi, is a highly vascularized and pigmented structure that is distinctive of reptilian eyes[20]. Braekevelt[21] studied ultrastructure of the conus papillaris in the bobtail goanna, *Tiliqua rugosa.* Alfayate *et al.*[22] studied ontogeny of the conus papillaris cellular response after optic nerve transection in the lizard *Gallotia galloti*: an immunohistochemical and ultrastructural study. The current study presents description of anatomical, scanning electron microscopy, and histological investigations of lens, cornea, retina, and conus papillaris of the Egyptian agama, *Trapelus mutabilis*, related to the diurnal activity.

MATERIAL AND METHODS

In Bir Al-Abd (Lat: 33 00' 00"N, Long: 33 01' 00"E), North Sinai, Egypt, during April and May (2019), six adult Egyptian agama lizards, *Trapelus mutabilis*, were captured and the dissection of specimens were performed in accordance with the guidelines of the Aswan University research ethics committee (Approval number: ASWU/05/SC/ZO/23-03/01). For anatomical study, sample heads were fixed in 10% formalin for two weeks before being preserved for a long time in 2% phenoxy ethanol. Images were taken with an Olympus microscope and a Toup camp XCAM full HD camera (model SZ61, Olympus Europa SE & Co. KG, Hamburg, Germany). According to previously published standards, the anatomical language for the skull and orbital tissue was established[23].

Small sections of eyes were cut for scanning electron microscopy (SEM) investigations, and they were immediately fixed for 48 hours at 4°C in 5% glutaraldehyde in a cacodylate buffer. Samples were post-fixed in a cacodylate buffered solution of 1% osmium tetroxide for 2 hours at 37°C after being rinsed three times in 0.1% cacodylate buffer. After that, the sample was washed three times in the same buffer, dried using an escalating series of ethyl alcohols, and then infiltrated for two days with amyl acetate. Samples were dried using critical point drying with liquid carbon dioxide. Samples were mounted and given a gold sputter coating. In the end, samples were analysed at 15 kv using a Jeol SEM (J S M-5400I V, Jeol Ltd, Tokyo, Japan).

The heads of the specimens were cut longitudinally into two halves for light microscopy studies. The samples were decalcified in EDTA for two weeks after being stored in 10% neutral formalin for three days. Following ethyl alcohol dehydration, the samples were cleaned in methyl benzoate for three days before being embedded in paraffin wax and serially sectioned (7 µm). The sections were stained using Masson's trichromic and hematoxylin/eosin stains[24]. A model DP74 Olympus camera attached to an Olympus microscope (model BX43) was used to capture the images.

Small sections of eyes were cut into 1.0 mm pieces and submerged for two hours in a cacodylate-buffered solution containing 5% glutraldehyde for transmission electron microscopic research (TEM). Following multiple for one hour washes in the same buffer (pH = 7.2), the samples were post-fixed for 2 hours at 4ºC in a cacodylate buffer solution containing 1% osmium tetraoxide. Samples were dehydrated using a graduated alcohol series after being rinsed multiple times as in the second phase. For light microscopic analysis, the samples were cut into sections (1.0 mm thick), set in epoxy resin, and stained with toluidine blue.

RESULTS

Anatomical and histological investigations of the lens of *T. mutabilis*

Lens of the Egyptian agama, *T. mutabilis,* is located posterior to the iris and occupies most the internal part of the eyeball and appears spherical with a biconvex surface. An anterior surface of lens is more convex than the posterior one with ~2.599 mm in diameter (Figure 1A&B). Histological investigation of the lens of *T. mutabilis* revealed that the anterior lens epithelium is composed of single layer of simple cuboidal epithelial cells with rounded nuclei and light cytoplasm. The epithelium of lens is located anteriorly to the sub-capsular cavity and capsulated by a thin cellular capsule. The epithelial cells become taller in the anterior peripheral region. Additionally, the lens contains thin concentrically arranged fibers to be thick in the core of middle region (Figure 1C&D).

Anatomical and histological investigations of the cornea of *T. mutabilis*

The cornea of the Egyptian agama, *T. mutabilis,* is a transparent thin-walled curved structure covers the front of the eye and connected with the scleral ossicles (Figure 2A&B). Diameter of the cornea is ~2.29 mm. Scanning electron microscopic investigation of the anterior surface of the cornea of *T. mutabilis* reveals that their surface of corneal epithelium provided with polygonal and irregular shaped intercellular borders and numerous microprojections (microridges) that coats by remnants of secretion (mucous) (Figure 2C&D). Histological investigation of the cornea of *T. mutabilis* reveals that the cornea is formed of five layers; epithelium, bowman’s layer, stroma, Descemet’s membrane, and endothelium (Figure 3A&B). Corneal epithelium covers the outermost surface of cornea and composed of 1-3 layers of non-keratinized epithelial cells with oval-shaped nuclei. The thickness of corneal epithelium measuring approximately 13.93 µm (Figure 3A). Bowman’s membrane represents the basement membrane of the corneal epithelium and anterior to corneal stroma (Figure 3A). Stroma contributes most of the structural framework of the cornea and locates between Bowman’s membrane and

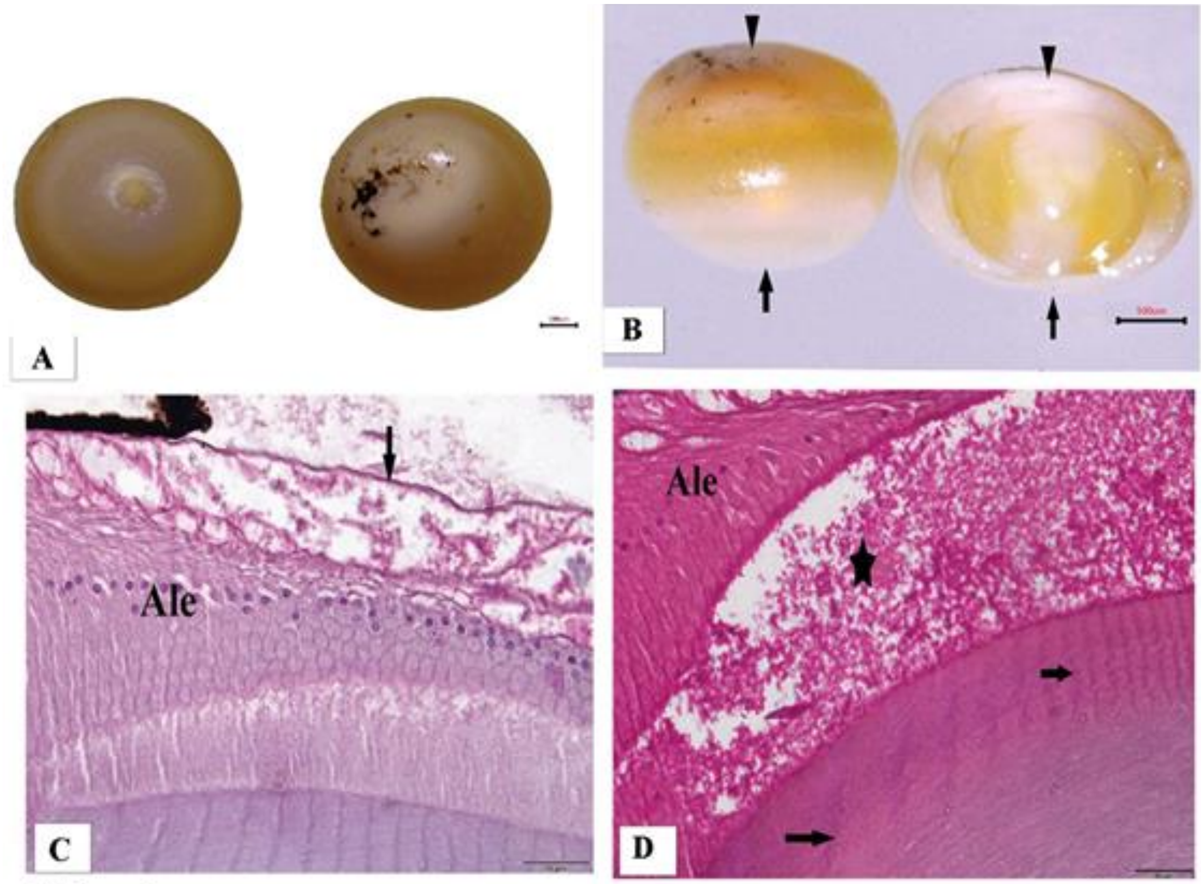

Figure 1: Photomacrograph of the lens of eye of the Egyptian agama, *Trapelus mutabilis*, showing the spherical and biconvex lens (A & B; scale bar = 500 µm). (B) Cross section through the lens showing an anterior surface of lens is more convex (arrowhead) than the posterior one (arrow). (C & D) Photomicrograph of transverse section of the lens of Egyptian agama, *Trapelus mutabilis*, showing the anterior lens epithelium (Ale) with simple cuboidal epithelial cells and capsulated by a thin cellular capsule (vertical arrow), subcapsular cavity (star) and thin concentrically arranged fibers (horizontal arrows) (C: hematoxylin and eosin stain, D: Masson's trichromic stain, magnification: 400×, scale bar = 50 µm).

Descemet's membrane. Thickness of stroma of cornea of *T. mutabilis* measuring approximately 20.80 µm. Histologically, stroma consists of collagen fibers and keratocytes (Figure 3A&B). Descemet's membrane is the fourth layer of cornea that locates between the stroma and corneal endothelium. This membrane is thin layer and represents the basement membrane of the corneal endothelium (Figure 3A). Endothelium is last layer of cornea lining the posterior surface of the cornea. Endothelium is formed of a single layer of simple squamous with rounded nuclei and measuring approximately 10.29 µm (Figure 3A).

Anatomical and histological investigations of the retina of *T. mutabilis*

The retina of the Egyptian agama, *T. mutabilis*, lining inner surface of eyeball. It is in immediate contact with vitreous chamber on one side and with the choroid on the other side. Retina is protected and held in the appropriate position by the surrounding sclera cartilage (Figure 4). Scanning electron microscopic investigation of the inner surface of retina showed that it contains projection with tiny pits (Figure 5B). In addition, the inner surface of retina contains a single fovea and deeply incised with rather gradual slopes at its edges (Figure 5A). Histological investigation

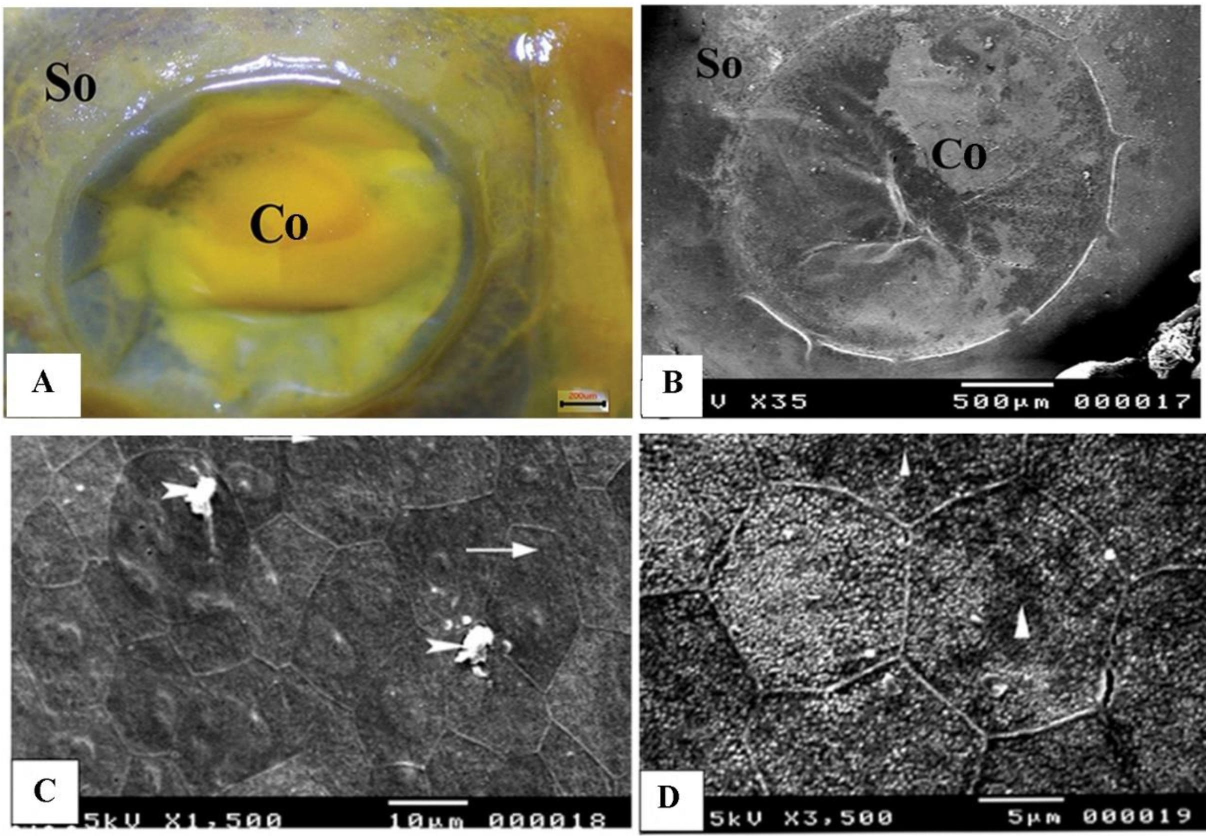

Figure 2: Photomacrograph of anterior portion of eye of the Egyptian agama, *Trapelus mutabilis,* after removing the eyelid (A) showing a transparent thin-walled curved structure cornea (Co) that covers the front of the eye and connected with the scleral ossicles (So) (scale bar = 200 µm). (B) Scanning electron micrograph of cornea of Egyptian agama, *Trapelus mutabilis,* showing cornea (Co) that covers the front of the eye (scale bar = 500 µm). (C) High magnification of the surface of corneal epithelium provided with polygonal and irregular shaped intercellular borders (arrow) that coats by remnants of secretion (arrowhead) (scale bar = 10 µm). (D) Surface of corneal epithelium provided with numerous microprojections (microridges) (arrowhead) (scale bar = 5 µm).

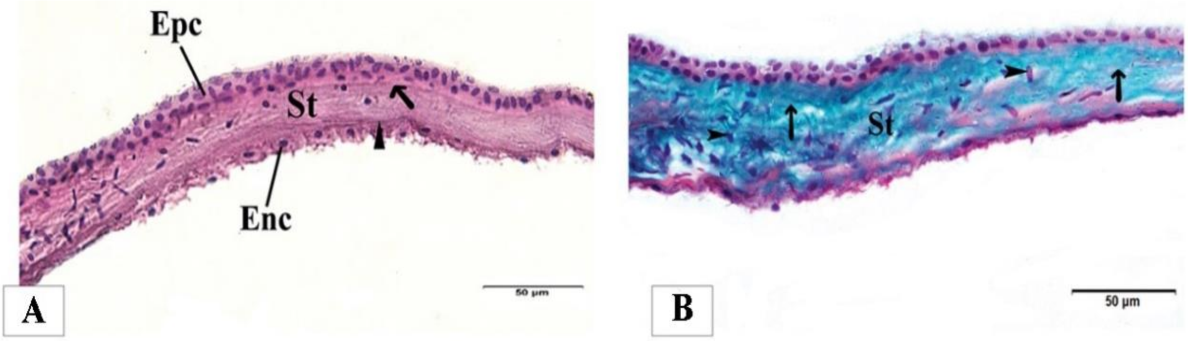

Figure 3: Photomicrograph of a transverse section of eye of the Egyptian agama, *Trapelus mutabilis* showing (A) the cornea composes of five layers: epithelium (Epc), bowman's layer (arrow), stroma (St), Descemet's membrane (arrowhead), and endothelium (Enc) (hematoxylin and eosin stain, magnification = 400×, scale bar = 50 µm), (B) corneal stroma (St) consists of collagen fibers (arrow) and keratocyte (arrowhead) (Masson'trichromic stain, magnification = 400×, scale bar = 50 µm).

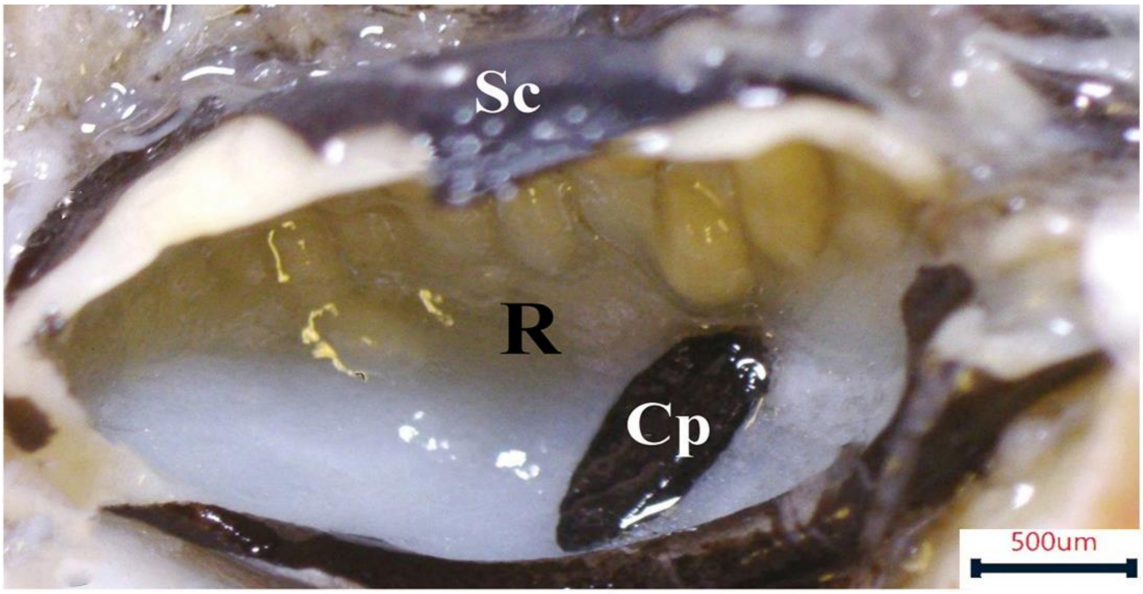

Figure 4: Photomacrograph of posterior portion of eye of the Egyptian agama, *Trapelus mutabilis*, showing retina (R) lining the inner surface of the eyeball, conus papillaris (Cp, a simple cone-shaped projection), and scleral cartilage (Sc) (scale bar = 500 μm).

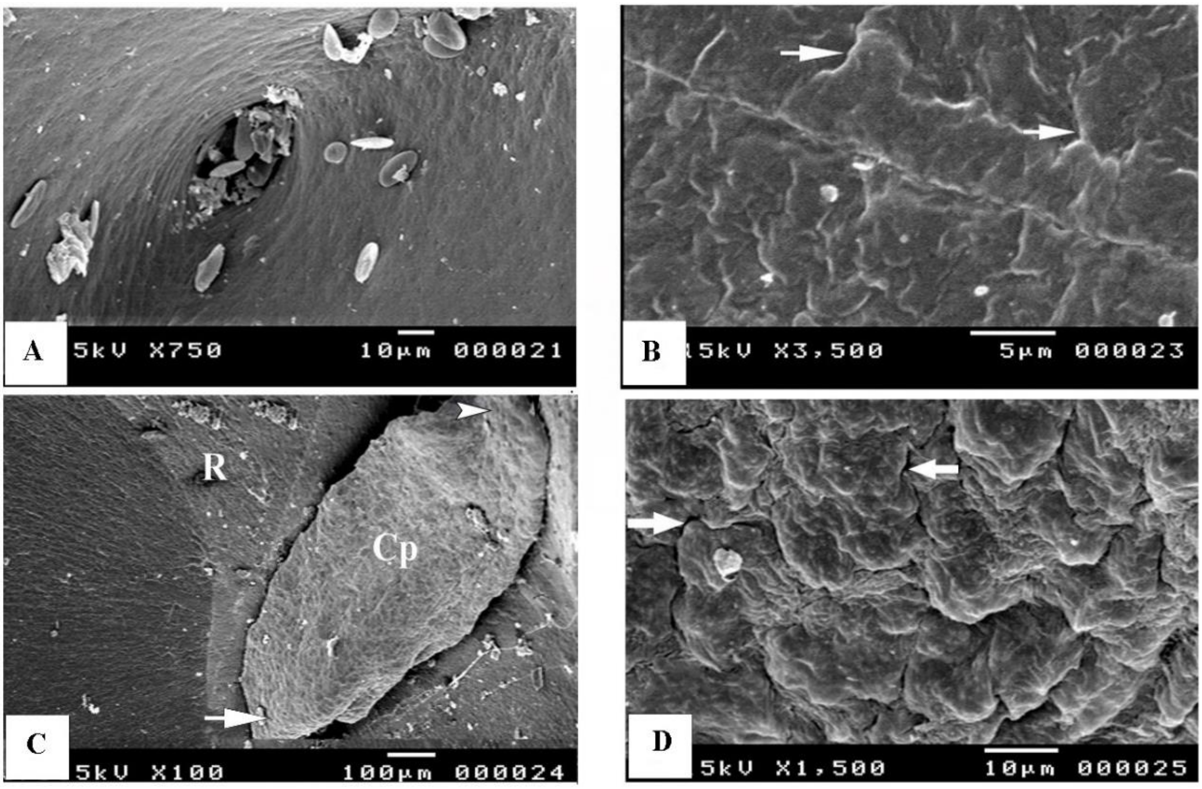

Figure 5: Scanning electron micrograph of the retina of the Egyptian agama, *Trapelus mutabilis*, showing (A) the inner surface of retina contains a single fovea and deeply incised with rather gradual slopes at its edges (scale bar = 10 μm), (B) the inner surface of retina contains projection with small pits (arrow) (scale bar = 5 μm), (C) conus papillaris (Cp) is cone-shaped structure protrudes from the retina (R) with broad base (arrowhead), which become narrow little toward its apex (arrow) (scale bar = 100 μm), (D) the surface of conus papillaris has projection with pits (arrow) (scale bar = 10 μm).

of retina revealed that retina is vascular, light-sensitive and multilayered structure lining the posterior inner surface of the eyeball (Figure 6B). The thickest retinal layers are located in the central region near the optic nerve (reaches up to ~291.49 µm) and the thinnest in the peripheral regions of the retina (reaches up to ~160.02 µm). The retinal layers represented by retinal pigmented layer, photoreceptor layer, cellular layers and neural one. Retinal pigmented layer that is adjacent to choroid layer and contained dark-brown granules. The photoreceptor layer of retina reaches up to ~16.45 µm thick and contained densely packed, elongated processes embraced posteriorly by retinal pigmented layer and by the outer limiting membrane anteriorly (Figure 6B&D).

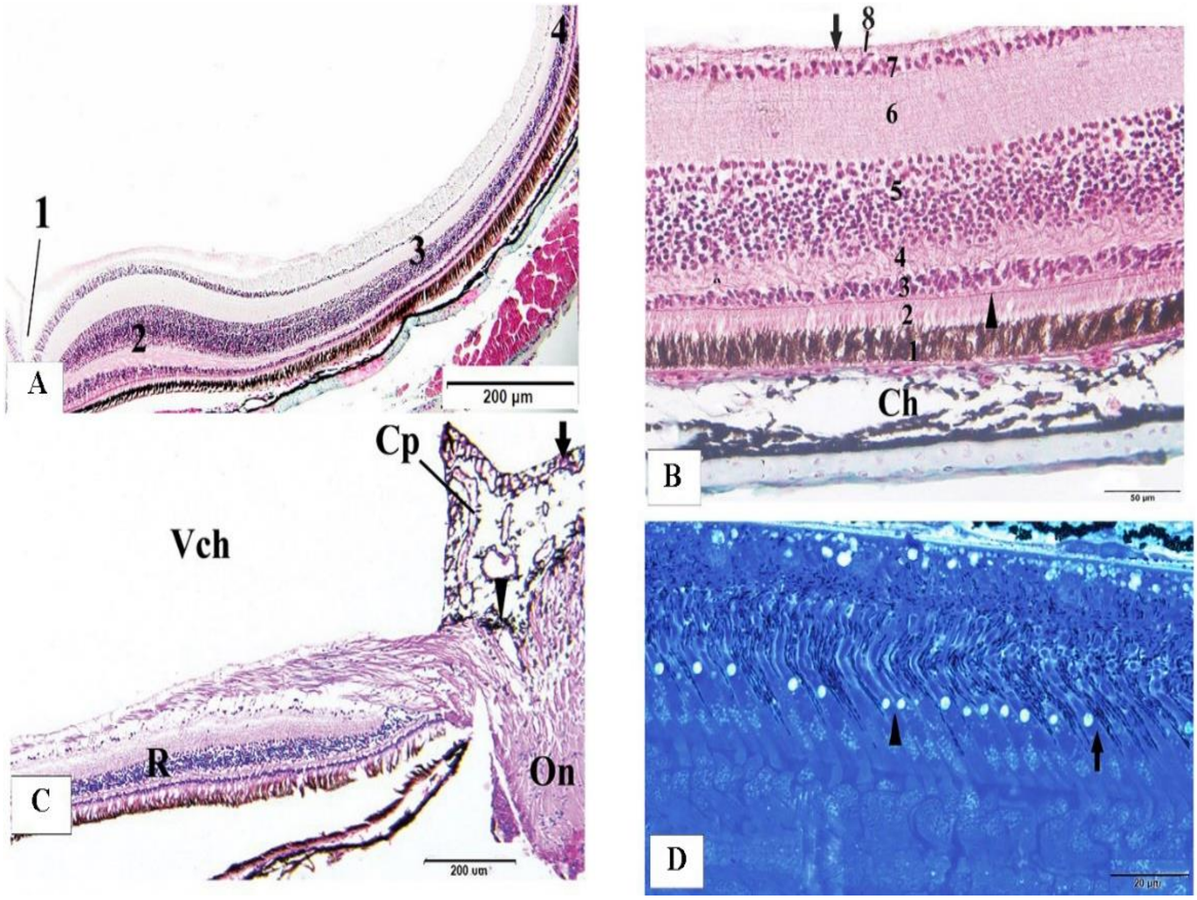

Figure 6: Photomicrograph of a transverse section of the retina of the Egyptian agama, *Trapelus mutabilis*, showing (A) the retina contains four different regions that can be distinguished as 1-foveal, 2-parafoveal, 3-extrafoveal, and 4-peripheral (Masson's trichromic stain, magnification = 100×, scale bar = 200 µm), (B) retina comprises several layers; 1-retinal pigmented layer, 2-photoreceptor layer, 3-outer nuclear layer, 4-outer plexiform layer, 5-inner nuclear layer, 6-inner plexiform layer, 7-ganglion cell layer, 8-optic nerve fiber layer, as well as outer limiting membrane (arrowhead) and the inner limiting membrane (arrow), and choroid (Ch) (Masson's trichromic stain, magnification = 400×, scale bar = 50 µm), (C) conus papillaris (Cp) arises from the base of the optic nerve (On) into the vitreous chamber (Vch) and consists of blood vessels (arrow) and many black pigment granules (arrowhead), retina (R) (Masson's trichromic stain, magnification = 100×, scale bar = 200 µm). (D) Photomicrograph of semi-thin section of retina of the Egyptian agama, *Trapelus mutabilis*, showing the retina contains single cones (arrowhead) and double cones (arrow) (Toluidine blue stain, magnification = 1000×, scale bar = 20 µm).

Semithin sections of the retina of *T. mutabilis* reveals that the photoreceptor layer of retina contains both single and double cones that form two cells of unequal sizes. That single and double cones present in all areas of the retina. Oil droplets are spherical situated in some single cones and within the principal member of double cones (Figure 6D). Retina of *T. mutabilis* comprises also three cellular layers and three neural ones, the outer nuclear layer, are followed by the outer plexiform layer, inner nuclear layer, inner plexiform layer, ganglion cell layer, optic nerve fiber layer and lastly the inner limiting membrane that is adjacent to vitreous chamber (Figure 6B). The outer nuclear layer lies anterior to the outer limiting membrane and measures ~10.84 µm. In the center, the outer nuclear layer is composed of five rows of the circular or oval photoreceptor cell nuclei and along the distal margin of the outer nuclear layer is arranged in a single row of photoreceptor cell nuclei. The outer plexiform layer measures ~18.18 µm, and consists of a mixture of processes of horizontal, bipolar neural cells. Inner nuclear layer consists of 10-16 rows of nuclei of horizontal, bipolar and amacrine cells decreased in the periphery. Inner nuclear layer measures ~66.38 µm. Inner plexiform layer composed of a meshwork of neuronal processes of cells of the inner nuclear layer and the ganglion cell layer. Its thickness measures ~52.22 µm. The ganglion cell layer consists of 1-3 rows of ganglion cells and measures ~15.65 µm. The optic nerve layer consists of ganglion cell axons and measures ~7.92 µm (Figure 6B).

The retina of *T. mutabilis* contains four different regions which can be recognized into: foveal, parafoveal, extrafoveal and peripheral. The foveal region is the region of foveal pit that is convexiclivate in shape with a thickness of approximately 402.99 µm. The foveal retina is slightly thinner than the extrafoveal retina. The parafoveal region is an annular region surrounding the fovea, in which the thicknesses of retina layers increase to a maximum that reaches up to ~929.87 µm. The extrafoveal region is between para-foveal region and periphery region. In the peripheral region, the thickness of the retina decreases gradually to ~205.73 µm (Figure 6A).

Anatomical and histological investigations of the conus papillaris of *T. mutabilis*

The conus papillaris of the Egyptian agama, *T. mutabilis*, is a simple cone-shaped projection, heavily pigmented and originating on top of the optic nerve that protrudes from retina into the vitreous chamber. The conus papillaris measures ~1.72 mm in length and ~0.60 mm in width. The basal of conus papillaris tapers slightly ~0.19 mm in width towards its free apex (Figure 4). Scanning electron microscopic investigation of the conus papillaris of *T. mutabilis* showing cone-shaped structure protrudes from the retina with broad base which become narrow little toward its apex (Figure 5C). The surface of conus papillaris has more projection with pits in the surface of retina (Figure 5B,C&D). Histological investigation of conus papillaris of *T. mutabilis* revealed that it is a highly vascularized structure arises anteriorly from the base of the optic nerve. The conus papillaris consists of blood vessels and many black pigment granules (Figure 6C).

DISCUSSION

Lens and cornea are necessary components of eye responsible for focusing light on the surface of the retina, form a complex unit, transparent and equipped with refractive power, known as refraction[25]. The lens of vertebrate eyes plays a vital role in maintaining transparency and refractive index[26]. The distribution of the refractive indices and variations in lens curvature cause variations in optical power[27]. Lens or cornea curvature allows the greater of light gathering capacity[28]. Lenses of reptilian animals are often elliptical and are focused by deformation. Some aquatic species have round lenses like that of the sea turtles that are deformable[29]. Also, snakes have round lenses that move toward and away from the retina to focus[15,28,30]. The present study revealed that the lens of *T. mutabilis* has a spherical like most of reptilian species[31,32].

The cornea serves as a barrier and is a key component of the eye's refractive system[33]. In many terrestrial reptiles, it is crucial for the refraction of light and lesser role in the refraction of light in aquatic reptiles[15,28,29,34]. The structure of cornea of *T. mutabilis* is vascular and transparent structure, with curved appearance, similar to that of other vertebrates[35]. For clear vision to be possible, the cornea must be structurally and functionally transparent. This provides a smooth optical surface and a protective goggle to guarantee a focused image on the retina as mentioned by Collin and Collin[36].

The apical epithelial cells have a polygonal shape and irregular borders similar to those of the ornate lizard, *Ctenophorus ornatus* and the loggerhead turtle, *Caretta caretta*[36,37] also these feature had been mentioned in the frog, *Rana pipiens* and the amphibian urodele, *Ambystoma mexicanum*[36,38]. Moreover, the epithelial cells of cornea are provided with microridges that increase the corneal strength and increase the surface area for mucous material to adhere to the corneal surface. Collin and Collin[36] pointed out that the microridges assist also in nutrition beside waste removal.

The vertebrate retina's basic structure consists of three cellular and three neural ones. The outer plexiform, inner nuclear, inner plexiform, ganglion cell, and optic nerve fiber layers follow the nuclei of the visual cells, which make up the outer nuclear layer, from sclerad to vitread[7]. However, size, shape, number and arrangement of both the visual cells and other retinal neurons vary between vertebrate groups. These variations reflect the habits and habitats of the different groups. Most notable are the adaptations of retina to nocturnality and diurnality[7]. Rods and cones are the typical divisions of visual cells in vertebrates. Rods predominate in the retina of nocturnal vertebrates. Contrarily, the population of rods is small or nonexistent in the retina of diurnal vertebrates, which has a large number of cones. Due to the connectivity patterns of the retinal neurons, diurnal animals' retinas also exhibit thick inner nuclear and inner plexiform layers[39]. Only cone photoreceptors, which can be further divided into single cones and double cones, are present in the retina of *T. mutabilis*. The cones' morphology is in accordance with descriptions of other diurnal lizards, and they are distinguished by an oil droplet and small conical outer segments[13,40,41]. Surprisingly, the retina of the diurnal scincid lizard Australian bobtail goanna, *Tiliqua rugosa* has been reported as having both rods and cones with a ratio of ~80:1, but without double cones[21]. A colored oil droplet with large concentrations of carotenoids is located at the distal end of the single cones and minor members of the double cones of the inner segment. This oil droplet allows light to pass through before it reaches the visual pigment. As filters, they serve to remove some wavelengths and narrow the pigments' absorption spectra, decrease the overlap of the responses of the pigments, and expand the range of colors[41].

Furthermore, the central position of retinal fovea corresponds well with lateral position of the eyes of *T. mutabilis* to the observed monocular fixation of detected food items as mentioned by Röll[8]. Other lizards with a single, centrally positioned fovea, like lacertids, iguanids, and agamids, also exhibit a monocular fixation of prey, suggesting that the fovea may be important in the detection and localization of live prey. Due to their eyes' extreme mobility, chameleons, which likewise have a single centrally placed fovea, can use it for binocular fixation[42]. High visual acuity is made possible by a well-developed central fovea and is utilised for monocular prey detection[8]. Some species of lizard, the retina comprises two areas of foveae: a shallow temporal fovea and a convexiclivate central one. Both diurnal geckos[7] and *Anolis* sp.[43,44] have been found to have a bifoveate retina. Thus, binocular vision is probably affected by the second fovea found in the temporal retina[7]. All components of the visual cells decrease in diameter from the periphery towards the foveal fossa, resulting in an increase in receptor density. In that diameter of the pedicles do not decrease accordingly, the pedicles are multilayered in the foveal and parafoveal regions. The pedicles are physiologically most relevant parts of visual cells, in so far as they are in contact other retinal neurons. Clearly this means that their diameters cannot be reduced below a certain minimum size[8].

Conus papillaris is a nutritive device for the inner retina[39]. Histological investigation of conus papillaris of *T. mutabilis* revealed that it consists of blood vessels that protrude from the optic disc into center of vitreous chamber. From the eye cup at the base of the conus papillaris, the optic nerve extended. In conclusion, the present study explained the anatomical and histological features of the lens, cornea, and retina of the eye of the Egyptian agama (*Trapelus mutabilis*) reflecting their adaptation to diurnal activity pattern, as well as central position of the fovea in retina with the lateral position of the eyes. Fovea increases visual acuity by monocular vision, which helps in speed detection of live prey.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interests.

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تكيف عين سحلية قاضي الجبل المصرية "*Trapelus mutabilis*" وفقـًا لنمط نشاطها

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تقدم الدراسة الحالية مناقشة موجزة عن بعض تراكيب عين سحلية قاضي الجبل "*Trapelus mutabilis*"، وفقـًا لنمط نشاطها النهاري. تعتبر العدسة والقرنية من المكونات الضرورية للعين المسؤولة عن تركيز الضوء علي سطح الشبكية. وتمتلك سحلية قاضي الجبل عدسة كروية محدبة الوجهين، وتتكون من طبقة واحدة من الخلايا الطلائية المكعبة البسيطة أمام تجويف تحت الكبسولة، وتتغلف العدسة بأكملها بواسطة كبسولة خلوية رقيقة. والقرنية عبارة عن امتداد أمامي منحني شفاف وهي رقيقة الجدران تغطي الجزء الأمامي من العين. من الناحية النسيجية، تتكون القرنية من خمس طبقات: طلائية، طبقة بومان، سدى، غشاء قاعدي، وبطانة. بينما تبطن شبكية العين السطح الداخلي لمقلة العين، التي تحتوي على بعض النتوءات ذات الحفر الصغيرة، وكذلك نقرة واحدة واسعة. طبقات الشبكية ممثلة بطبقة شبكية مصبغة وطبقة مستقبلات ضوئية وطبقات خلوية وطبقة عصبية. تحتوي طبقة المستقبلات الضوئية لشبكية العين على خلايا مخروطية مفردة ومزدوجة. والعضو المخروطي هو عبارة عن بنية مخروطية الشكل، مصطبغ بكثافة، وينشأ على قمة العصب البصري الذي يبرز من شبكية العين إلى الغرفة الزجاجية. سطح العضو المخروطي به نتوءات أكثر مع حفر. من الناحية النسيجية، يتكون العضو المخروطي من أوعية دموية وعديد من حبيبات الأصباغ السوداء. وخلصت الدراسة الحالية إلى أن العدسة وشفافية القرنية ذات المظهر المنحني، والمستقبلات الضوئية المخروطية فقط لشبكية العين كلها تعكس تكيفها مع نمط النشاط النهاري لسحلية قاضي الجبل المصرية.