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Microstructural Studies on Lens of Pteropus Giganteus with its Physiological Significance

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ABSTRACT

Lens of Pteropus giganteus is found to be 2.05mm. The medulla and cortex are well organized. Crystallinity of lens fiber is prominent in both cortex and medulla. Lens fibers show wavy nature when magnified. The presence of fine particles (.3 nm) in lens fibrils indicates the presence of some cylindrical scatters. The collagen fibril diameter is found to be about 30 nm and the center-to-center spacing is about 50 nm. The significance of these micro structural features of lens and its role in visual physiology of P. giganteus is discussed.

Introduction

The most important Photoreceptor structure in both compound type and camera type eyes is "Dioptric apparatus" or lens. Involvement of lens in the visual system seems extensive and varied. They act as interferences filters in the eye ,help in reflection of specific wave lengths from regions behind the receptive cells, reduces reflection on the eye and do selective light absorption ([2]Bernhard, *et. al.*, 1965 and Somiya, 1976).The lens is formed by embryological invagination of the ectodermal cell layers. The equatorial context is elongated fibers with numerous protrusions. In the central part of the cells are irregular and sparse invagination. (Kuwabara. 1970).

In both compound eye (insects) and camera type eyes (vertebrate) the role of these refractive structure is seems to be extensive and varied. . They may act as interferences filters and may reduce reflection of undesirable amount of light, reflect specific wavelengths from regions behind the receptor cells. Further they help in selective light absorption of light ([2]Bernhard, *et. al.*, 1965 and Somiya, 1976).

The structure of the eye of *P. giganteus* is constructed along the general vertebrate plan. The eye consists of cornea, lens and retina. The lens is a transparent, highly refractive structure. A capsule encloses it. The histological features of the lens shows concentric discontinue suggestive of growth increments. The lens is characterized by the presence of two distinct regions the central medulla or the nucleus and the outer cortex. The older cells are found in the medulla and the younger towards the periphery (Cortex). Elongation of the meridonial rows of epithelial layer is seen, which results a junta-position of the apical surfaces of the anterior epithelial.

The shape of the lens is elliptical. The cortical fiber cells are not attached to the capsule and extend from one structure plan to the other. They are elongated hexagonal cells that taper slightly. The hexagonal fibers (cell) have two long and four short sides. The cells are closely packed and without nucleus (Fig.1).

The angles at the junction of the short sides are referred to here as apexes. The wide sides are parallel to the surfaces (Fig.1). Hexagonal cells are found in the bow area, which also contains belt like shaped cells. Both horizontal and vertical plan of the structure is seen in rabbit lens. The lenticular fibrils are parallel in arrangement. The fibers are smooth with low nipple structure. There is a gap of 0.1µm to 01µm in between each fibril. The surface of the fiber has many ball and socket forms of interdigitation. The plasma membrane exists in the form of gap junction. The gap junction varies 0.1µm to 01µm. This implies that the fiber cells always remain in metabolically coupled state. The medullary cells are irregularly belt shaped cells. The medullary fibrils are also arranged in a linear fashion with a gap of 2µm to 4 µm in between. More ball and socket but few surface ridges or mounds are seen.

Cortical lens fibers show ball (B) and socket (S) interdigital flap (FL) extend from the angles at the junction of the short and long ridges (fig.2). The balls consists of a short stalk which expands to form a spherical head embedded in a complementary depression in the adjacent fibers. Ball is approximately 1.5µm in diameter and the depression of sockets is approximately 2µm (identical to monkey) and numerous surface ridges in the lens like that of man.

Materials and Methods

Scanning Electron Microscopy: Lens after excising from the eye was cut with a fine razor blade and were secured horizontally to a brass stub (30mm dia x 20mm high) with the cut surface facing the electron beam of the microscope. A thin electron conductive metal coating was applied to the specimen using gold as a target metal in a fine coat ion sputter coater, JSM 1100 (joules). Observations were made with electron microscope JSM-35CF (joules) using the secondary electron emissions made at an accelerating voltage of 15 KV and at a working distant of 1.5 KV and at a working distance of 1.5 mm. Four individual of the species representing both males and females are used for the study.

Results and Discussion

A. Begumorganization of lens of *P.giganteus* is more or less same as other vertebrate species. However the lenticular fibers were found to show comparatively greater degree crystallinity which suggests that the lens is only refractive

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element with high refractive index(Feng *et al,2005* and A.Begum, 2009) The lens fibers were found to scatters report in some vertebrate cornea ([1] Autrum, 1979). The vertebrate eye is reported to provide an example of apex scattering by cylindrical scatters in the ocular media. It is known to consists of two layers of cell,the epi and endothelia and a central stroma. A similar type of situation appears to be present in the lens of *P.giganteus.* If this is true than the effect of the phase relation and direction of scatters from every fibril must be taken into account in order to estimate the intensity of scattering light. [11] Maurice (1968) calculated that if there was no co-relation in phase that is if fibrils acted as independent scatters than the ocular refractive structure would be opaque. Since the lens of *P.giganteus* is transparent it is safe to conclude that the collagen fibrils do not act as independent scatters. Crystalline materials are known to approach most closely to condition of a uniform refractive index necessary to minimise scattering in mica compared with that of glass In our present study also we observed a high degree of crystallinity in the lens of *P.giganteus*. This suggests that despite the presence of lens fibril in the form of particles the crystalline materials of uniform refractive index cap play a role in minimizing scattering.(A.Begum 2010 & Goswami, U.C.; Begum,A and Dey, S. (2000)

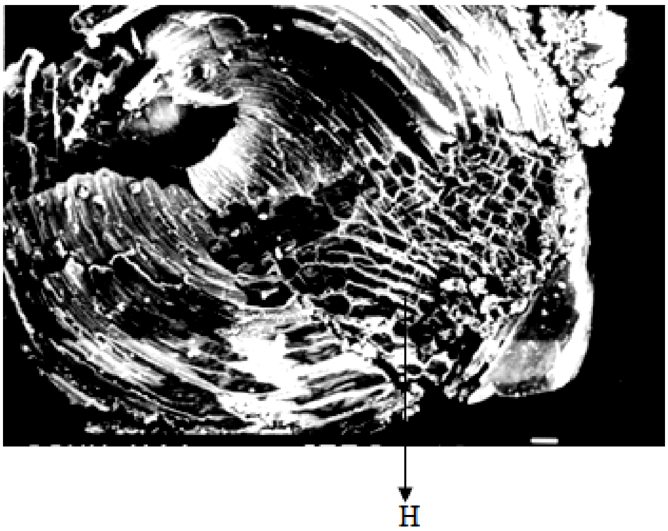

Figure 1. Scanning electron micrograph of the lens of P. giganteus showing the(H) Hexagonal fibers (cells). Bar =100 µm

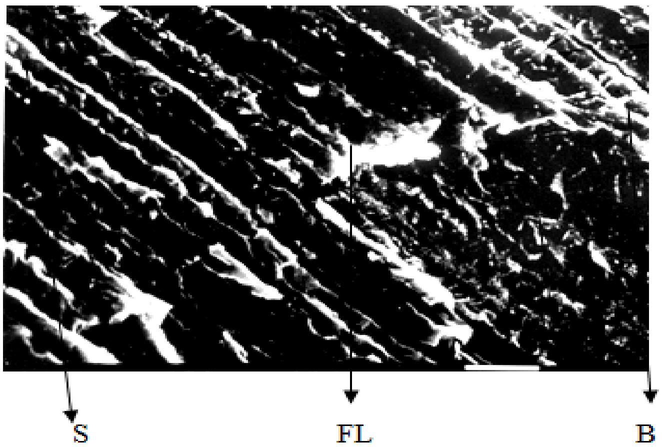

Figure 2. Scanning electron micrograph of the lens of P. giganteus showing the junctional apparatus like lenticular fibers with ball (B), socket (S), and intergital flaps(FL) of the lenticular fiber (cells). Bar = 10 µm

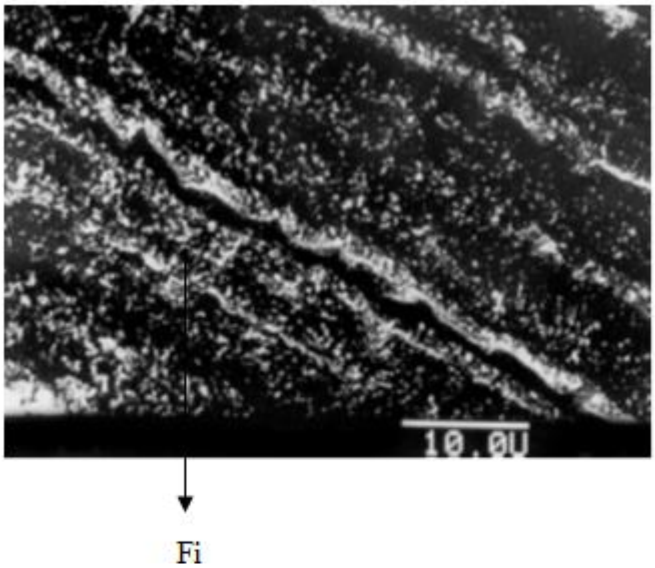

Figure 3. Scanning electron micrograph of the lens fibers of P.giganteus showing packed with fine particles (Fi)

In order to explain the transparency of ocular refractive structures, Maurice, 1957 in his classical experiment compared the arrangement of the stromal fibril to crystalline lattice structure. He observed that each row of fibrils with long axis lying perpendicular to normal incidence illumination of the cornea acts as a diffraction grating. It was suggested that the whole array of fibrils in the lamellae acts as diffraction grating to scatter light at normal incidence where the wavelength is less than the interfibrilar spacing.

Our present observation suggests that a similar type of situation exists in the lens of *P.giganteus*. This type of arrangement was found to contribute to reduction of transparency at shorter wavelengths. We have studied in the role of lenticular fibers in fresh water fishes and showed its significance in visual physiology (Goswami *et al,* 1998 and 2000).[7,8]

Transparency of the ocular media is important for the absolute sensitivity function of scotopic receptor as well as for photopic receptor because maximal intensity at the receptor and lack of scatters are important for contrast detection of visual activity. An estimate of the optical density of the ocular media caused by absorption and scatter is therefore important for understanding photoreceptor function.

The structural features suggesting the possible existence of scatters in lens of *P.giganteus* indicates that their visual system is not cute. However crystalline structures of lens suggest some transparency. Hence it may not be correct to that *P.giganteus* has no or poor vision. Some vertebrate corneas that have clear vision also exhibit the scatterings as indicated by structural features. It is however very clear that the lower wavelength the transparency of lens is very low.

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