The ultrastructure of the retina of some limpets (Mollusca: Patellogastropoda)

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Gastropod eyes are diverse in structure. The Patellogastropoda (limpets) have structurally simple eyes located at the base of their cephalic tentacles. Each eye is cup-shaped, lacks a lens, and is lined with a single layer of retinal cells (Figure 1). The gastropod retina is usually composed of two functional cell types; light sensitive photoreceptor cells and shading pigment cells. Conflicting information exists on the types and structure of the retinal cells of patellogastropods. Fretter and Graham (1994) described the retina as having two cell types (pigmented and unpigmented) neither of which were ciliated. Marshall & Hodgson (1990) and Arendt, Hausen & Purschke (2009) reported that the retina had only one cell type, a combined light-sensitive photoreceptor and shading pigment cell. Furthermore, Marshall & Hodgson (1990) did not report any cells with cilia, whereas Arendt *et al.* (2009) illustrated all the retinal cells with cilia. The aim of this study, therefore, is to clarify the retinal cell structure in patellogastropods.

Nine species from three families of patellogastropod were collected from rocky shores of South Africa. The cephalic tentacles of at least three specimens of each species were removed at their base and fixed in 2.5% glutaraldehyde in 0.2M sodium cacodylate buffer and 3% sucrose (pH 7.2) at 4^{o}C. The tentacles were then processed by standard methods for TEM. Thin sections (1μm) were stained with toluidine blue and light microscope images were captured with an Olympus BX40 microscope fitted with a DP72 digital camera. Ultrathin sections (90 - 100 nm) were stained with uranyl acetate and lead citrate and were viewed with a Zeiss Libra 120 TEM at 120kV.

The retina of all species examined consisted of two types of columnar cell, pigmented and photosensory (Figure 2a). The pigment cells have a basal oval nucleus with peripheral heterochromatin and a prominent nucleolus. The peri-nuclear cytoplasm contains some mitochondria, endoplasmic reticulum and bundles of tonofilaments. Most of the cytoplasm is filled with membrane-bound, electron dense pigment granules. At the apical end the pigment cells bear elongate microvilli (about 10-15 m) that contain microfilaments extending into the cytoplasm (Figure 2b). Only one type of photosensory cell is present in the retina. It has an irregularly shaped basal nucleus and cytoplasm containing well-developed Golgi bodies, some endoplasmic reticulum, elongate mitochondria, multivesicular bodies and lysosomes. Most of the cytoplasm is filled with densely packed photic vesicles and at the apical end there are elongate microvilli and a few cilia (Figure 2b). This structure is typical of the rhabdomeric receptors of many gastropod eyes.

Our reinvestigation of retinal structure of patellogastropods confirms that this taxon have one of the simplest forms of eye, but as in other gastropod taxa it is composed of not one but two cell types, pigmented and sensory (both with apical microvilli), and that the latter only bear cilia.

References

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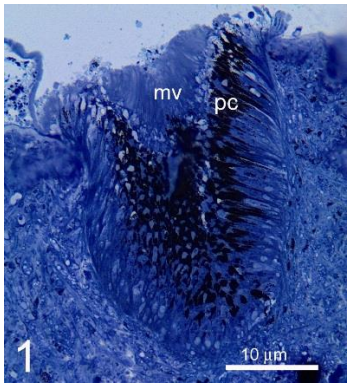

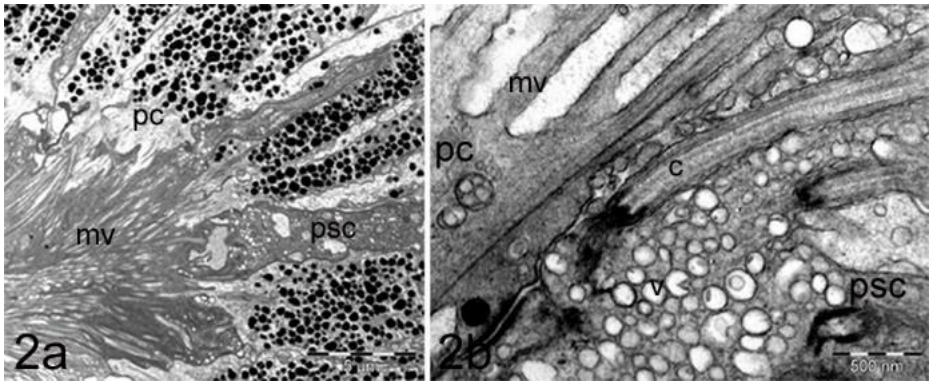

Figure 1. Light micrograph of a patellogastropod (*Scutellastra granularis)* eye stained with toluidine blue. pc, pigment cells; mv, microvilli.

Figure 2a. TEM image of the eye showing the two cell types. pc, pigment cell; psc, photosensory cell; mv, microvilli. 2b. Higher magnification of the apical region of the retinal cells. pc, pigment cell; psc, photosensory cell; mv, microvilli; c, cilia; v, optic vesicles.