

【Grant-in-Aid for Scientific Research(S)】
Biological Sciences (Biology)



Title of Project : Molecular bases of the differences in the physiology and cell biology between rods and cones

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Research Area : Basic biology

Keyword : Animal physiological chemistry

【Purpose and Background of the Research】

Our visual sensation is mediated by two types of photoreceptors, rods and cones (Fig.1A). Both respond to light electrically (Fig.1B). Rods are highly light-sensitive but cones are not (Fig. 1C). Because of this sensitivity difference, rods mediate night vision and cones mediate daylight vision. While a response to a brief light flash is rather slow in rods, it is brief in cones (Fig.1B). The purpose of this study is to understand the molecular bases of these differences. In addition to these differences in the electrical responses, rods and cones are different in other aspects: the shape of the cell is different and the energy metabolisms seem to be different. These differences could be important for a rod to be a rod and for a cone to be a cone. In this study, we will also try to understand the cellular bases of these differences.

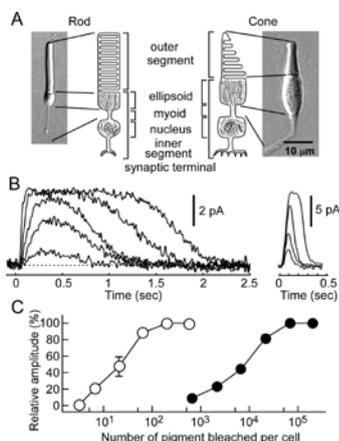


Fig. 1 Rod and cone differences. (A) A carp rod (left) and a carp red cone (right) and their schematic drawings. (B) A family of light responses in a rod (left) and a red cone (right) to a light flash of various intensities. (C) Relations between flash intensity and response amplitude in rods (left) and cones (right) determined from the records in (B).

【Research Methods】

Purification of cones in an amount enough to do a biochemical study used to be difficult, but

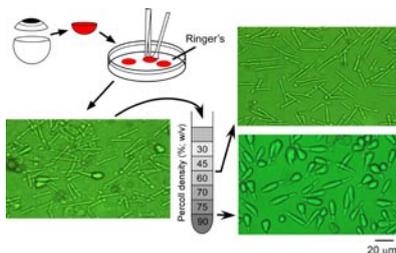


Fig. 2 Purification of carp rods (upper right) and cones (lower right) with use of density gradient centrifugation.

fortunately we succeeded in it with taking advantage of the difference in the bouillon density between rods and cones (Fig.2). With use of these preparations, we will compare the generation mechanisms of a light response between rods and cones to understand the molecular bases of the differences in the light response. In addition, we will try to understand the rod and cone differences at the cellular level.

【Expected Research Achievements and Scientific Significance】

Current our knowledge on the molecular mechanisms of generation of a light response in photoreceptor cells is limited almost to rods. However, our daily life vision is mediated cones, not rods, and therefore, our study will provide key information about the molecular mechanism of our daylight vision.

【Publications Relevant to the Project】

- Takemoto, N., Tachibanaki, S., and Kawamura, S. (2009) High cGMP synthetic activity in carp cones. *Proc. Natl. Acad. Sci. USA.* 106: 11788-11793.
- Miyazono, S., Shimauchi-Matsukawa, Y., Tachibanaki, S., and Kawamura, S. (2008) Highly efficient retinal metabolism in cones. *Proc. Natl. Acad. Sci. USA.* 105: 16051-16056.
- Tachibanaki, S, Arinobu, D, Shimauchi-Matsukawa, Y, Tsushima, S. and Kawamura, S. (2005) Highly effective phosphorylation by G protein-coupled receptor kinase 7 of light-activated visual pigment in cones. *Proc. Natl. Acad. Sci. USA.* 102: 9329-9334.

【Term of Project】 FY2011-2014

【Budget Allocation】 67,600 Thousand Yen

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