Analysis of molecular property of ascidian opsin, Ci-opsin1

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Opsins are photoreceptive proteins in animals which belong to G protein-coupled receptors (GPCRs). Ci-opsin1, ascidian (Ciona intestinalis) opsin, was found to be expressed in the ocellus of ascidian larvae to regulate the swimming behavior. The phylogenetic analysis indicated that Ci-opsin1 was more closely related to vertebrate visual opsins than invertebrate ones. However, the detailed molecular properties of Ci-opsin1 remain unknown. Our spectroscopic analysis indicated that Ci-opsin1 showed intermediate photoisomerization of the retinal to form a visible light-sensitive pigment and activated Gi after light-induced charge separation, which leads to the stabilization of the radical pair. The structural change may affect optical spectra of an electron transfer cofactor in the photosynthetic reaction center.

Photoisomerization of the retinal. These results suggest that Opn5 subgroup found in non-mammalian vertebrates was reconstituted with 11-cis retinal to form a visible light-sensitive pigment and activated Gi after cis-trans photoisomerization of the retinal. These results suggest that Opn5 group shares G protein coupling property and is diversified based on their spectral sensitivities.

Molecular Properties of mouse melanopsin

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Melanopsin is the photosensitive pigment of ipRGCs (intrinsically photosensitive Retinal Ganglion Cells), which mediate irradiance detection functions such as pupillary light reflex and photoentrainment of the circadian rhythm. Although melanopsin’s physiological relevance is well established now, its molecular properties remain largely unexplored. In order to address this gap in our understanding, we have characterized melanopsin’s molecular properties, using recombinant mouse melanopsin exogenously expressed in culture cells. We have conducted a comprehensive analysis of spectroscopic properties of mouse melanopsin and of its Gq activation properties. Based on these results, we discuss the possible consequences of such molecular properties on irradiance detection. Photosynthesis is characterized as a multi-scale reaction system. Chlorophyll a fluorescence induction (FI) shows such a property of photosynthesis. To understand this phenomenon, a number of studies based on various mathematical models have been attempted. However, there are problems: (1) understanding of phenomenon based on very complex model is difficult and (2) high computation cost is required for integration over multi-time-scale. Here, a reduction method of coarse-graining in time which resolves these problems is applied to PSII model for exciton and electron transfer kinetics. Analysis of FI based on coarse-grained model of PSII indicates that light-intensity dependent branching off of reaction path occurs.