The Complex Research of Photoisomerization Process of Rhodopsin Retinal

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The human eye contains two types of light-sensitive cells (photoreceptors): highly sensitive rods are responsible for night vision, and less sensitive cones are responsible for color vision. Rhodopsin - a light-sensitive pigment (chromoprotein). The rods of the eye retina of marine invertebrates, fishes, almost all terrestrial vertebrates and man contain the rhodopsin (approximately 40%). Rhodopsin - the main visual pigment responsible for the color of the retina and the perception of electromagnetic radiation in "visible range", underlying in vision process. Rhodopsin consists of two components. The part that absorbs visible light is called a chromophore - retinal (aldehyde of retinol (vitamin A)), and the protein of the visual pigments, which are bound to retinal, called opsin.

The mammalian rhodopsin structure is similar to bacteriorhodopsin - the membrane proteins of Archaea. The halophilic archaea has the ability to carry out extremely non-chlorophyll type of photosynthesis. Bacteriorhodopsin carries proton transfer across the plasma membrane.

As is known, the absorption of a photon by rhodopsin leads to a number of its photochemical transformations - photolysis. The primary act in this process is the isomerization of 11-cis-retinal to all-trans form, which has the same chemical structure as the cis-form, but a different physical structure - a straight, not bent molecule. The absorption of a photon leads to the weakening of bonds in the retinal molecule and subsequent repulsion of the methyl groups located in different planes, according to the retinal structure, causing the rotative moment that causes the molecule to straighten the bend with rotation.

After absorption of light energy rhodopsin begins to disintegrate. Since the orientation of the reactive sites of all-trans-retinal no longer fits in with the orientation of the protein reactive sites of opsin, this form of retinal begins to separate from opsin. "Strained" conformation of isomerized chromophore transforms its energy into further conformational changes of rhodopsin. In vertebrates photolysis ends with separation chromophore from the protein (opsin) and output of retinal.

The method of computer modeling has been reproduced the photoisomerization process of retinal. For this aim HyperChem program was used. The experiment showed that the absorption of a photon leads the electron density distribution in such way that the charges on the ends of the retinal molecule coincides with the charge of the environment, as a result of the electrostatic interaction leads to the ejection of retinal out. This is accompanied by the release of the channel in the cell membrane. The photolytic decomposition of rhodopsin causes the excitation of the visual nerve due to changes in ion transport in the photoreceptor.