LATERAL DIFFUSION OF RHODOPSIN IN THE VISUAL RECEPTOR MEMBRANE

Mu-ming Poo and Richard A. Cone

The Thomas C. Jenkins Department of Biophysics, Johns Hopkins University, Baltimore, Md. 21218

If the rhodopsin on one side of an isolated rod outer segment is suddenly bleached, the rhodopsin on the other side can be observed with a microspectrophotometer to diffuse rapidly across the width of the rod. Uniform distribution is approached exponentially with a half-time at 20°C of 23 ± 3 sec in rods isolated from mudpuppy (Necturus maculosus) retina and 35 ± 3 sec in rods isolated from frog (Rana catesbeiana) retina. These rods are 12 and 8 μ in diameter, respectively. Taking the geometry of the rod disk membranes into account, we obtain a lateral diffusion constant for rhodopsin in the disk membrane of $(4.0 \pm 1.5) \times 10^{-9}$ cm^2/sec for both mudpuppy and frog. No diffusion was observed if rods were first fixed with glutaraldehyde. The diffusion constant increased with temperature with a Q_{10} between 2 and 4 in the temperature range near 20°C. If the effective diameter of rhodopsin is assumed to be about 50 Å, the Stokes–Einstein relationship implies the effective viscosity for lateral diffusion of rhodopsin is about 2 poise. This value, as well as the Q_{10}, are essentially the same as indicated by the rapid rotational diffusion of rhodopsin previously observed by flash photometry in frog rods.*

*Cone, R. A., Rotational Diffusion of Rhodopsin in the Visual Receptor Membrane, Nature (London) New Biology, 236:39 (1972)

Journal of Supramolecular Structure