

# Molecular properties of rhodopsin responsible for rod function.

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Rod and cone photoreceptor cells that are responsible for scotopic and photopic vision, respectively, exhibit photoresponses different from each other and contain similar phototransduction proteins with distinctive molecular properties. To investigate the molecular properties of rhodopsin responsible for rod function, we have generated knock-in mice in which rhodopsin was replaced with mouse green-sensitive cone visual pigment (mouse green), whose molecular properties are considerably different from those of rhodopsin. Single cell recordings of wild-type and homozygous rods suggested that the flash sensitivity and the single-photon responses from mouse green were 3-4 times lower than those from rhodopsin. Noise analysis indicated that the rate of thermal activation of mouse green was about 900 times higher than that of rhodopsin. The increase in thermal activation of mouse green relative to that of rhodopsin would not be expected to affect the reduction of sensitivity to bright light, but would instead be expected to affect visual threshold under dim-light conditions, where the true light signals would be overwhelmed by dark noise due to the higher rate of thermal activation. Therefore, the ability of rhodopsin to generate a large single photon response and to retain high thermal stability in darkness are factors that have been necessary for the evolution of scotopic vision.