Simultaneous measurements of membrane current and intracellular Ca^{++} changes using the Ca^{++} indicator ARSENAZO III. (Limulus ventral nerve photoreceptor)

I. Ivens, H. Stieve

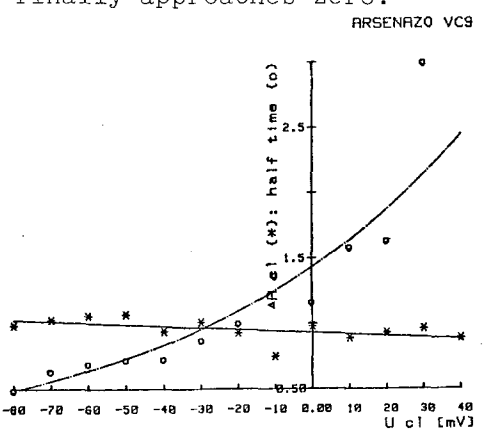
Institut für Neurobiologie der KFA, D-5170 Jülich, FR Germany

Intracellular free Ca^{++} $[Ca^{++}]_i$, which increases following illumination is believed to control the sensitivity of the photoreceptor cells. The mechanism of the increase in $[Ca^{++}]_i$, which comes ultimately from the extracellular space, is not yet understood.

In LIMULUS photoreceptors the Ca^{++}-sensitive dye Arsenazo III was preassure-injected by a microelectrode and the increase of free $[Ca^{++}]_i$ measured as absorption increase.

Simultaneously with the absorption change, following a 10 ms light flash, the receptor potential or the membrane current under voltage clamp conditions were alternatingly recorded.

The light induced Arsenazo response consists of a rapid absorption increase (time to peak 200 - 1000 ms) which is followed by a slower absorption decrease (half time ca. 1 - 5 s) which finally approaches zero.



The Arsenazo signal depended in height and shape on the clamped membrane voltage (Fig.) The absorption signal measured during voltage clamp was normalized in respect to the unclamped signal (= 100 %) recorded one minute later. The amplitude of the normalized Arsenazo response (ΔA_{cl}) decreases with the membran clamp voltage, while the normalized half time of the decrease of the Arsenazo response increases with the clamp voltage.

ΔA_{cl} decreases linearly and can be extrapolated to zero in the range of ca. + 500 mV, which may be the reversal potential for calcium of the photoreceptor, possibly indicating that the driving force for the increase in $[Ca^{++}]_i$ might be the calcium gradient across the plasma membrane.

Supported by Deutsche Forschungsgemeinschaft (SFB 160)