

Dependence of Membrane Conductance of *Limulus* Ventral Nerve Photoreceptor on $\text{Ca}^{2+}/\text{Na}^{+}$ -binding Competition

H. Stieve, M. Pflaum and J. Klomfaß

Institut für Neurobiologie der KFA, D-5170 Jülich, F.R. Germany

Membrane current vs voltage curves were measured in *Limulus* ventral nerve photoreceptors using the voltage clamp technique.

Lowering the external concentration of the divalent cations Ca^{2+} and Mg^{2+} to $< 1 \mu\text{mol/l}$ by adding EDTA causes

- 1) the light induced conductance increase to disappear and
- 2) the reversal potential of the membrane current in the dark (V_{REVJ_D}) to shift (from a value between -30 and -40 mV) to a positive value (between +10 and +20 mV). This value is about 5-10 mV smaller than the reversal potential of the light induced membrane current (V_{REVJ_L}) under normal conditions.

If the Na^{+} -concentration is lowered to 50 mmol/l (i.e. 10% of the normal concentration) simultaneously with the lowering of the divalent cation concentration described above, the light response is not abolished and V_{REVJ_D} is shifted not so much. The extent of this effect depends on the sodium substitute: If choline is used as sodium substitute, lowering sodium causes a quantitative better protection from the effect of the reduction of divalent cations as compared to sodium substitution by lithium.

Lowering of sodium to 50 mmol/l alone, in a saline containing normal Ca^{2+} and Mg^{2+} concentration, does not change the membrane dark current vs voltage curve and so V_{REVJ_D} is not altered; it reduces however V_{REVJ_L} by 10 mV (from +20 to +10 mV) with no great difference between the two Na-substitutes used. A reduction in V_{REVJ_L} can be accounted for by the reduction of the sodium gradient across the cell membrane.

In the lithium containing salines no light induced outward current (at membrane potentials clamped to positive values) could be observed.

Lowering the external Na^{+} -concentration (to 10%) has a significant effect on membrane conductance only in a saline which is very low in divalent cations.

The results are consistent with our working hypothesis (1) that opening and closing of the light channels in *Limulus* ventral nerve photoreceptor is controlled by negative binding sites for which calcium- and sodium ions compete with antagonistic actions.

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