

Inhibition of Anodic Galvanotaxis of Green Paramecia by T-Type Calcium Channel Inhibitors

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Calcium ion (Ca^{2+}) is one of the key regulatory elements for ciliary movements in the *Paramecium* species. It has long been known that members of *Paramecium* species including green paramecia (*Paramecium bursaria*) exhibit galvanotaxis which is the directed movement of cells toward the anode by swimming induced in response to an applied voltage. However, our knowledge on the mode of Ca^{2+} action during green paramecia anodic galvanotactic response is still largely limited. In the present study, quantification of anodic galvanotaxis was carried out in the presence and absence of various inhibitors of calcium signaling and calcium channels. Interestingly, galvanotactic movement of the cells was completely inhibited by a variety of Ca^{2+} -related inhibitors. Such inhibitors include a Ca^{2+} chelator (EGTA), general calcium channel blockers (such as lanthanides), inhibitors of intracellular Ca^{2+} release (such as ruthenium red and neomycin), and inhibitors of T-type calcium channels (such as NNC 55-0396, 1-octanol and Ni^{2+}). However, L-type calcium channel inhibitors such as nimodipine, nifedipine, verapamil, diltiazem and Cd^{2+} showed no inhibitory action. This may be the first implication for the involvement of T-type calcium channels in protozoan cellular movements.

Key words: Calcium Signaling, Galvanotaxis, Inhibitor, *Paramecium bursaria*