OR324

Honeybee Kenyon cells are regulated by a tonic GABA conductance

Mary Palmer

The higher cognitive functions of insects are dependent on their mushroom bodies (MBs), which are particularly large in social insects such as honeybees. MB Kenyon cells (KCs) receive multisensory input and are involved in associative learning and memory formation. In addition to receiving sensory input via excitatory nicotinic synapses, KCs receive inhibitory GABAergic input from MB feedback neurons. Cultured honeybee KCs exhibit ionotropic GABA receptor currents, but the properties of GABA-mediated inhibition in intact MBs are currently unknown. Here, using whole-cell recordings from KCs in acutely-isolated honeybee brain, we show that KCs express a spontaneous tonic current that is inhibited by picrotoxin but not by bicuculline. The tonic current is reduced by inhibition of Ca^{2+} channels with Cd^{2+} or nifedipine, but is unaffected by the GABA uptake inhibitor nipecotic acid or by the GABA transaminase inhibitor vigabatrin. Bath application of GABA (5 mM) and taurine (1 mM) activate a tonic current in KCs, but L-glutamate (0.1-0.5 mM) has no effect. The spontaneous tonic current is strongly potentiated by the allosteric GABA(A) receptor modulator pentobarbital. Noise analysis of the GABA-evoked current gives a single-channel conductance value for the underlying receptors of 27 ± 3 pS, similar to that of RDL receptors. Using recordings of KC membrane potential, it was found that action potential firing was evoked by less injected current following inhibition of the tonic current with picrotoxin. Thus, the tonic GABA receptor conductance in KCs acts to reduce neuronal excitability, a property that is likely to contribute to the sparse coding of sensory information in insect MBs.