

## Neurotransmitters of the cardiac ganglion in the penaeid shrimp, *Maruspenaeus japonicus*

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A few studies on the neurotransmitters of cardiac ganglion neurons have been reported although there are many anatomical and physiological studies on the cardiac ganglion in decapod crustaceans. It has been proposed for the hermit crab heart that dopamine and acetylcholine may be transmitters of, respectively, large cardiac ganglion neurons and small cardiac ganglion neurons (Yazawa and Kuwasawa 1992). Glutamate has been proposed as a cardiac ganglion transmitter in the lobster (Delgado *et al.*, 2000).

We studied effects of putative crustacean neurotransmitters on the isolated heart of the adult penaeid shrimp, *M. japonicus*. GABA had inhibitory effects on heartbeat. Acetylcholine, dopamine, octopamine, serotonin and glutamate, all these had excitatory effects on the heart in heart rate and in contraction force. Dopamine and glutamate caused depolarization of myocardial cells, and increased myocardial tone. When the preparations were perfused with TTX-containing saline, glutamate caused an increase of myocardial tone accompanied by depolarization of myocardial cells. Joro spider toxin (JSTX) inhibited spontaneous heartbeat. JSTX also inhibited excitatory junctional potentials in the myocardial cells which evoked by electrical stimuli applied to the cardiac ganglion. It is likely that glutamate is an intraganglionic neurotransmitter of the cardiac ganglion in *M. japonicus*.