Muscle physiology in escape response of kuruma shrimp *Penaeus japonicus*

クルマエビの逃避反応における筋肉生理特性

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【Objective】Kuruma shrimp react to threatening stimuli by producing a series of escape response by 'tail-flip' movements. These tail-flips are completed by alternate flexions and extensions of the abdomen, which thrusts the shrimp backwards through the water. The main function of such escape behavior is clearly the avoidance of dangers including fishing gear. The present study examined how the shrimp responds to the given stimuli such as; tapping on the rostrum and forcing to swim at various water flows. Further tests on the muscle contraction time and tail-flips power output were also conducted in order to examine the performance of abdominal muscles for escape response.

【Methods】Escape response of shrimp was examined in a 4.0 m long swimming channel, by stimulating to perform tail-flipping repeatedly until they failed to respond. This performance was measured in terms of sequence of bouts (each series of tail-flips, starting with the stimulus to the rostrum and finishing when the shrimp resettles) by using the video recording. The swimming endurance time was determined by forcing the shrimp to swim against the various speeds of water flows in a flume tank. Muscle contraction time and tail-flips power output were also examined by using an oscilloscope and load measurement devices at various temperatures for 10 to 25 °C.

【Results】A tactile stimulus to the rostrum of the shrimp resulted in an elevated trajectory, mostly achieving the mean escape path height of 0.14 m. The average number of tail-flips in a tail-flipping bout was 2.0±1.45, which propelled the shrimp over a distance of about 0.4±0.14 m in one tail-flip. The maximum accumulated tail-flipping distance recorded was 11.87 m, while over-all mean distance was 6.17 m. The mean tail-flipping speed was 0.88 m/s in one complete tail-flip. Swimming endurance test within 2 hrs revealed that the sustained speeds of 30.0 cm/s were estimated. Muscle contraction time was faster when the temperature was elevated. Results showed no significant differences between contraction time and shrimp size at the same temperature. The higher tail-flips power output was obtained in larger shrimps, while temperatures were not related.