Short Paper

Respiration of the Kuruma Prawn in Air Conditions

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The trend in commercial live transportation of marine animals is for reduction of the volume of seawater used to keep the animals alive during transport. Reduction in the volume of seawater allows more animals to be shipped at a time, thereby greatly reducing transport costs. The technique in the live transport of the kuruma prawn *Penaeus japonicus* uses chilled sawdust as a transport medium. However, mortalities still occur to some degree, and the mechanism of the prawn's endurance in air has not been studied at all. The present study revealed the abilities and characteristics of the respiration in prawn exposed to air.

For the respirometric experiment, a closed system connected with gas meters and a respiratory chamber was prepared similar to the previous study.¹⁾ Concentration changes of O₂ and CO₂ gases of air in the equipment were monitored for 4 h or until the scale was exceeded on the CO₂ meter whose measurable maximum was 4975 ppm. The measurements were conducted individually, using intermolt prawns of 26.8–33.9 g body weights. They were brought from Aira Prawn Farming of Iwasaki Industry Co., Kagoshima. They had been reared in its field ponds at 21–23°C. After wiping thoroughly the prawn body, each was put into the respiratory chamber controlled to 15°C or 20°C in an incubator. The concentrations of O₂ and CO₂ were measured by a minimum scale of 0.1% and 25 ppm, respectively. To determine the O₂ consumption rate, the concentration difference in the period from the time of the initial shift down, in the step-like change of the decreasing

O₂ concentration, to the time of the final shift down, near the experiment end, was obtained. As for the CO₂ excretion rate, data were similarly obtained for the above period. Blank tests followed the method in the previous study.¹⁾

All experimental prawns were alive during the respirometric experiment, without showing any active behavior such as moving or flapping. The concentration changes of O₂ and CO₂ showed the evident respiratory activities of the prawn in air conditions. One example of the respirometric experiment at 15°C is presented in Fig. 1. At 15°C, five specimens yielded respiratory rates of 50 ± 4.7 ml O₂/kg·h and 19 ± 4.8 ml CO₂/kg·h (mean plus S.D.). The respiratory quotient (R.Q.) was calculated to be 0.38 ± 0.07 . At 20°C, the mean plus S.D. of the O₂ consumption and CO₂ excretion rates in five specimens were 100 ± 10.9 ml O₂/kg·h and 36 ± 4.3 ml CO₂/kg·h, respectively. R.Q. was 0.36 ± 0.08 . Further, as concerns Q₁₀, the temperature effect was specific; a difference of only 5°C yielded twofold rates of O₂ consumption. This Q₁₀ has been similarly reported in the kuruma prawn kept in water.²⁾

The respiratory rate in resting prawns of 14.8–18.2 g was reported to be 77 ml O₂/kg·h at 22.9°C.³⁾ Larger prawns of 20°C in the present study ought to have consumed less oxygen than the above ones,⁴⁾ when they were kept in water. The present result indicated an acceleration of O₂ consumption or intake in the prawns exposed to air. However, this acceleration was largely depressed by lowering the air temperature to 15°C. Therefore, lowering the temperature could be a reasonable treatment for prawn transportation. Regarding R.Q., the main energy source has not been specified in prawn species⁵⁾; viz. lipid in *P. monodon*,⁶⁾ protein in stressed *P. monodon*⁶⁾ and starved *P. esculentus*.⁷⁾ The present value of R.Q. was extremely low by comparison to the value of 0.7, which assumed lipid to be the energy substrate. As concerns this interpretation, the present low R.Q. would have occurred due to an abnormal intake of O₂ in addition to the ordinary respiration in air conditions. Further, it seemed also probable that metabolic CO₂ had been incorporated into the Wood-Werkman reaction in the midgut gland.⁸⁾ Incidentally, respiratory rates of the young Reeve's turtle *Geoclemys reevesii* were 133 ± 34.5 ml O₂/kg·h and 93 ± 24.1 ml CO₂/kg·h, and R.Q. was 0.70 ± 0.06 at 17°C in the preliminary experiment.

Fig. 1. Concentration changes of O₂ and CO₂ in the respiratory equipment due to air breathing of the prawn.

The step-like character of O₂ is due to direct plotting of the monitor's values.

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