Short Paper

Oxygen Uptake Rate and Heart Rate of Small Abalone *Sulculus supertexta* as Related to the Ambient Oxygen Concentration

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The small abalone (tokobushi in Jpn.) *Sulculus supertexta* Haliotidae, has a good commercial value in Japan when purchased in living condition. Therefore, it is important to keep them alive until cooking. This work was intended to know the effect of ambient oxygen concentration on oxygen uptake rate and heart rate, because it was one of the most important environmental factors in stocking and transport in living condition.

Abalones of about 40–60 g (7 cm in shell length) were caught in Miura Peninsula, Kanagawa, in summer, cleaned of the fouling organisms and kept in an aquarium supplied with running sea water for a few days, during which they were fed with kelp *Ecklonia cava* until one day before measurement. After measuring the weight and size, the part of shell which covered the heart was removed just to see the heart beat one day before measurement, because the opaque covering over the heart would make it difficult to see the heart beat long after opening the shell. The soft part of body was 73–78% of the whole abalone, whose specific gravity was about 1.3 and used for the correction of respirometer volume. The temperature and chlorinity were steady during the experiment and changed less than 0.3°C and 0.3‰ respectively.

A 1.5 l-sized glass chamber was used as a respirometer, which had a glass cover equipped with a stirrer and a Galvanic cell oxygen analyzer¹⁾ which was calibrated by the Winkler's method everyday.²⁾ The chamber was immersed in a water bath of running sea water which also flowed through the chamber. After making an abalone rest in the chamber by keeping it there for more than 4 h, the oxygen uptake rate was measured by the decrease in oxygen concentration in the closed chamber. The chamber was lit with a dim light during measurement.

The lower routine or standard oxygen uptake rate was about 27 ml/h/kg of whole shell and the active rate could be more than 52 ml/h/kg (Fig. 1); 36 and 69 ml/h/kg of soft part respectively. The active rate was similar to the data (probably lower routine rate) of the same species³⁾ and of *Haliotis discus hannai*⁴⁾ under similar condition.

The incipient lethal level of oxygen was about 1.5 ml O₂/l or 30% of air-saturation at the temperature of about 25°C; the chlorinity of water was about 18‰. Below this level, abalones often lifted the shell as if to assist gills easily in contacting more water. The left border of the area where the data of O₂ uptake rate vs. O₂ concentration scattered was a single line which seemed to pass the origin (Fig. 1) especially below the incipient lethal level; a part of the upper limit of activity scope as in the case of Japanese spiny lobster.⁵⁾ The O₂ uptake by other than the abalone, probably by bacteria in water, was less than 3% that by the abalone. It was used for the correction.

Fig. 1. O₂ uptake rate and heart of *Sulculus supertexta* as related to the ambient oxygen concentration.

Open and solid symbols are the heart rate and O₂ uptake rate respectively. Circles are for the specimen of 50 g in body weight (measured during 14:10–16:11), rhombi 51 g (21:21–0:15) and triangles 42 g (10:31–14:11).

The heart rate was about 61/min and steady above 2.8 ml O₂/l or 55% air-saturation, below which it decreased gradually (Fig. 1). The rate was higher than those of *Haliotis gigantea*, *H. discus discus* and *H. madaka*, probably because our abalones were smaller than the above mentioned abalones.⁶⁾ During the measurement the shells always attached to the wall. Any diurnal change was not observed in both rates in this experiment, though slightly lower rates of O₂ uptake were measured at night (20:21–21:46). A similar phenomenon on O₂ uptake was also reported.⁸⁾

Since the pH and reserve pH were more than 8.0 at the end of measurement, the partial pressure of carbon dioxide was less than 0.5 Torr.^{6,7)} The adverse effect was not expected.

References

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