Oxygen consumption and resting metabolism of post-hatching cuttlefish *Sepia officinalis* (Linnaeus, 1758)

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**Abstract**

Oxygen consumption of post-hatching cuttlefish, *Sepia officinalis* (Linnaeus, 1758), up to the age of 48 days was investigated in the laboratory trial. Total of 139 animals were subjected to respirometry measurements. The oxygen consumption ranged from 129.316 to 479.7371μg O2 g.-1h.-1 (mean oxygen consumption 280.5348 ± 77.7149μg O2 g.-1h.-1). Statistical relation between oxygen demand and body weight and age show decrease with both independent variables respectively.

Key words: oxygen consumption, resting metabolism, cuttlefish.

**Introduction**

Cuttlefish, *Sepia officinalis* (Linnaeus, 1758) is temperate and tropical water cephalopod species that lives solitary in circalittoral space, down to 200 m. The cuttlefish migrates seasonally inshore (Bakhaykho i Drammeh, 1982), and spawns in shallow waters. The eggs are layed at depths rarely greater than 40 m, and in waters of southern Adriatic sea usually at 7-15 m (Glavic, 2007). The animal is semelparous, and the spawning is characterized as intermittent terminal (Rocha et al., 2001). The water temperature is already documented as a major factor affecting overall metabolic activity of aquatic organisms (Magnuson et al., 1979), and oxygen consumption expressed as P50 (Brix et al., 1994.). Available oxygen in turn influences the distribution of cuttlefish (Johansen et al., 1982). Therefore, we can characterize the temperature as a limiting factor for cuttlefish (Fry, 1971). These measurements were conducted to get insight into respiration rate, resting metabolic needs and costs of young cuttlefish in relation to size and time after hatching, during first 48 days of life.
Materials and methods

Oxygen consumption was measured on cuttlefish that hatched from eggs laid in the laboratory. Parental stock of adult cuttlefish (m=378±84g), six females, were collected at the river Neretva mouth (40°01’37.11’’N and 17°25’02.62’’E) from a depth of 7-9m (S=36psu, t=13ºC), on march 23rd 2005. In all, 616 eggs were layed on the plastic mesh placed vertically in the holding tank by at least three females. After 67 days, first young cuttlefish started to hatch. After the hatching, young cuttlefish were fed daily live misids, species *Hemimysis lamornae mediterranea*, Bacescu, 1936. The measurements of resting metabolic rate (RMR) started with the very hatching process, that took place in the respirometric chamber. The method used was constant volume respirometry, because of small weight of subject (0.09-0.56g). The cylindric respirometric chamber, 38.9cm³ volume, was fitted with Clarke’s polarographic measuring element (Radiometer type E 5046) and signal analyzer (Radiometer type PHM 72). Salinity was kept at 35-39psu, and temperature 16.8-23.5ºC. The measurement intervals were set at 30 min, and the oxygen levels, as partial pressure of O2 was recorded every 5min. The temperature difference did not exceed 2.0ºC. For each of 8 weekly measurements, 18 animals were chosen, making total of 145 measured cuttlefish. All groups of data were subjected to Kolmogorov-Smirnov normality test (p<0.20), and histogram of group data were produced to assess the within-group distribution pattern. Repeated measures ANOVA (p<0.05) was used on age groups of data to reveal the influence on cuttlefish respiratory activity. Simple linear regression of log-transformed data was used to show the trend of the respiratory activity dependence to the age and wet weight of juvenile cuttlefish. All statistical analyses and graphs were produced using Statsoft Statistica v 7.0 for Windows.

Results and discussion

In total 139 animals (BW 0.09-2.19g, mean BW 0.432g, SD ± 0.300385g) were measured. All respirometric data were obtained under normoxic water conditions (PO2, Pw0=134 mm Hg, Pwt=102 mm Hg, eg.%sat. at 80-120). The temperature in the acclimatation tanks, as well as inside of the respirometer chamber was kept at the average values of 21.6±0.914ºC. The salinity of the sea water was ambiental, and has changed significantly through the experiment (31.00-40.00psu, avg 37.02psu), and has to be addressed to as an independent variable. The mean oxygen consumption throughout the experiment was 280.5348 ± 77.7149 μg O2g.-1h.-1, min. 129.316 μg O2g.-1h.-1, max. 479.737 μg O2g.-1h.-1. The highest average oxygen consumption was measured in two weeks post hatching cuttlefish. The results of ANOVA statistical analysis shows that age is a significant determinant of young cuttlefish specific respiratory activity (univariate repeated measures ANOVA, F=3.470505, p=0.005459). Regression of the log weight-specific oxygen consumption to the log wet body weight of post-hatching cuttlefish showed decrease in oxygen demand with the increase in weight, and could be expressed by the equation: logVO2 = 2.3546 - 0.1673*log BW. The correlation coefficient r=-0.3976, and the determination coefficient R²= 0.1581, N=140 (p<0.05). Graphical depiction of trend is given on figure 1. Also, oxygen consumption was regressed to the age of young cuttlefish, up to the 49-th day of life. Regression showed that there is a trend of decreasing oxygen demand in cuttlefish with age (fig 2). Comparing cuttlefish oxygen consumption to the commercially cultured fish such as seabass, *Dicentrarchus labrax* yields significantly lower oxygen demand for seabass (65, 160, 360 and 340 mg O2 g^-1 h^-1 at 10, 15, 20 and 25 ºC respectively, (Claireaux and Lagardère, 1999). However, Johansen et al. (1982) state that cuttlefish oxygen demand is lower that the one in commercially cultured prawns.
Conclusion

Results show strong statistical relationship between oxygen consumption and wet body weight and age of cuttlefish, indicating decrease of oxygen demand with age and with the increase of body weight. Also, as indicated in the literature on the subject, the oxygen demand of cuttlefish falls between that of commercially cultured fish and prawns.

References


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