

Effects of handling on oxygen consumption and random activity in the freshwater mullet *Rhinomugil corsula* (Hamilton)

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Abstract. Handling caused excitement which resulted in lower random activity associated with higher rate of oxygen consumption. The routine and standard oxygen consumption rates were increased by 260 and 238%, and 291 and 277% at 30° and 35° C respectively. The temperature effect (30-35° C) did not cause a marked difference ($P < 0.05$) in the rate of oxygen consumption and random activity in *R. corsula*.

Keywords. Handling ; oxygen consumption ; random activity ; respirometer ; *Rhinomugil corsula*.

1. Introduction

Although the rate of oxygen consumption in relation to several factors has been extensively studied in fishes (Spoor 1946 ; Beamish 1964 ; Kutty 1968, 1972 ; Kutty and Peer Mohamed 1975 ; Peer Mohamed and Kutty 1981 ; Peer Mohamed 1981), information on the impact of handling is inadequate (Kutty 1968, 1972 ; Brett 1964 ; Smit 1965). In majority of the studies, the experimental fish was kept in the respirometer for some time in order to recover from the effects of handling, if any, because handling causes excitement and/or random activity to increase (Fry 1967). It has also been reported that the respiratory quotient (RQ) of goldfish and rainbow trout (Kutty 1968) and *Tilapia mossambica* (Kutty 1972) is frequently over unity during periods of excitement. Wedemeyer (1972) found that coho salmon and steelhead trout required 24 hr for normalization of several blood chemistry imbalances after handling. Since it is not known how handling would influence oxygen requirement in fishes, there is need for such information especially on selected cultivable fishes. The present investigation provides an insight on the effects of handling on oxygen consumption and random (spontaneous) activity in the freshwater mullet, *Rhinomugil corsula* (Hamilton). The observations were made at 30° and 35° C ; the high temperatures were chosen because of its relevance to local conditions and because the mullet is exposed to such high temperatures during a good portion of the year.

2. Material and methods

R. corsula, collected from Vaigai Reservoir in South India, ranged in total length from 17.0 to 17.4 cm (mean 17.3 cm; $N = 9$) and in weight from 40.5 to 43.5 g (mean 42.1 g) were used. Fish were acclimated and the observations were made at 30° and 35° C. Two series of experiments were carried out by using a modification of Fry's respirometer (Kutty *et al* 1971) at high ambient oxygen (air saturation); (i) control fish (the fish was left in the respirometer overnight after handling and before experiment and (ii) 'handled' fish (immediately after netting and introducing into the respirometer). The experimental procedure followed was as described in Kutty and Peer Mohamed (1975). Dissolved oxygen in the water samples (50 ml), collected just before and after the closure of the respirometer, was measured by using unmodified Winkler technique (APHA 1955). The random activity was counted by the difference between the initial and final figure of the electronic counter, noted after each sampling. Data obtained on the rate of oxygen consumption and random activity were analysed for fitting regression lines in semilogarithmic grid by least square technique.

3. Results

Regression equations of oxygen consumption (ml/kg/hr) against random activity (counts/hr) in *R. corsula* at 30° and 35° C are given in table 1. Mean values of routine and standard oxygen consumption (extrapolated values to zero activity) and random activity are also included in table 2. The high and low rates of oxygen consumption were estimated to be 98 and 115 ml/kg/hr (30° C) and 105 and 128 ml/kg/hr (35° C) in control fish (series i); 459 and 350 ml/kg/hr at 30° C and 420 and 360 ml/kg/hr at 35° C in *R. corsula* immediately after handling (series ii). The random activity of the fish in series (ii) was low (0-9 counts/hr) and high (10-31 counts/hr) in series (i).

4. Discussion

In the results presented (table 1), a positive correlation between oxygen consumption and random activity in *R. corsula* is noted in both the series (i and ii), which coincides with the observations made earlier in the same species by Kutty and

Table 1. Regression equations ($\log Y = a + bX$) of oxygen consumption (ml/kg/hr) (Y) against random activity (counts/hr) (X) in *Rhinomugil corsula*.

Series (i)—Control fish

$$\log Y = 1.95704 + 6.00342 X \text{ (30° C)}$$

$$\log Y = 1.98213 + 0.00414 X \text{ (35° C)}$$

Series (ii)—'Handled' fish

$$\log Y = 2.54873 + 0.01161 X \text{ (30° C)}$$

$$\log Y = 2.55895 + 0.00713 X \text{ (35° C)}$$

Table 2. Routine and standard oxygen consumption, and random activity in *Rhinomugil corsula*.

	Series	30° C		35° C	
		Routine (mean \pm S.E.)	Standard	Routine (mean \pm S.E.)	Standard
Oxygen consumption (ml/kg/hr)	i	105.7 (7) \pm 2.6	90.6	114.7 (7) \pm 3.1	96
Oxygen consumption (ml/kg/hr)	ii	382.1 (12) \pm 8.3	354	387.5 (12) \pm 6.0	362
Random activity (counts/hr)	i	19.3 (7) \pm 2.7	...	18.4 (7) \pm 2.7	...
Random activity (counts/hr)	ii	2.8 (12) \pm 0.7	...	4.0 (12) \pm 1.0	...

In the case of routine values mean \pm S.E. is indicated. Values in parenthesis denote the number of determinations.

Series i and ii denote control and 'handled' fish respectively (see text).

Peer Mohamed (1975). But, the present data differ from those of Kutty *et al* (1971) in that they observed much higher levels of random activity for *R. corsula* and also a break in activity-oxygen consumption relationship. It is possible that the discontinuity in the relation of oxygen consumption and activity is not evident in the present data because of the narrowness of the range of activity (Kutty 1968 ; Kutty and Peer Mohamed 1975).

The routine and standard oxygen consumption of the control fish (series i) are almost the same as observed earlier (Kutty and Peer Mohamed 1975). It is evident from the results (table 2) that, on comparison of series (ii) with series (i), an upward shift in the rate of oxygen consumption was observed. The routine oxygen consumption rate was shifted by 260 and 238%, and standard rate by 291 and 277%, at 30° and 35° C respectively. The present results thereby suggest that the fish were excited due to handling which resulted in lower random activity associated with high rate of oxygen consumption, that is, the less active the fish, the proportionately higher its energy cost. Fishes could, however, respire up to a level as high as the active metabolic rate due to excitement (Fry 1967). It is likely that the elevated oxygen consumption during lower random activity in the 'handled' fish is accomplished in part by an increase in the transfer factor of the gills (Randall *et al* 1967), that is, the effective exchange area of the gills is increased which results in an increase in the osmotic movement of water. In freshwater, the water moves down the osmotic gradient into the animal.

At both the test temperatures, the rate of oxygen consumption and random activity values are in close proximity and the test of significance showed that the values at 30° and 35° C are not significantly different ($P < 0.05$), suggesting that

the temperature effect (30°–35° C) is minor. This is possible, probably because these temperatures are close to each other and also within the upper range to which *R. corsula* is adapted for the greater part of the year.

It is obvious from the present observations that handling has its effects on oxygen consumption and random activity in the mullet, *R. corsula*. The effects of handling on the movement of water in fish should be recognised especially by anyone taking blood samples by any method that may excite the fish and thus elevate oxygen uptake and water movement. The fact that the water movement may dilute or concentrate blood constituents should be taken into consideration (Don Stevens 1972). Further study into the metabolic effects will widen the horizon on the energy cost of fish—aerobic and/or anaerobic.

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