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Metabolism of *Puntius sarana* (Hamilton) (Pisces: Cyprinidae) in Relation to Random Activity

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O_2 consumption, CO_2 production and N H_3-N excretion increased with increase in random (spontaneous) activity under adequate ambient oxygen (air saturation) at 30° and 35°C in *Puntius sarana*. Under aerobic condition increase in random activity did not affect the RQ which remained near unity. At both 30° and 35°C the AQ showed a positive trend, suggesting that increased protein degradation and utilization are associated with increased activity. At an average AQ of 0.08 (30°C) and 0.085 (35°C), the estimated values of total O_2 consumed for oxidising proteins were 24% and 27% at 30° and 35°C respectively; the remaining 76% and 73% were accounted for by carbohydrates and/or fats. The regression coefficients of metabolic rates and quotients are not significantly different ($P > 0.05$), suggesting that the temperature difference (30°-35°C) does not seem to cause a marked difference per unit change in effort—random activity—in *P. sarana*.

Key Words: **Metabolism, Random activity, Respiratory quotient, Ammonia quotient,** ***Puntius sarana***

Introduction

Knowledge of factors affecting metabolic rate of fishes can be applied to the practices of fishery management (Winberg 1956) and can also be used as a means of assessing the responses of fishes to environmental conditions (Fry 1947 and Brett 1970). Since metabolism studies in relation to several factors, especially random activity, has been studied extensively in some fishes (Kutty 1968, Brett 1970, Peer Mohamed 1974, Kutty & Peer Mohamed 1975 and Peer Mohamed 1982), there appears to be lack of information to describe the metabolism of the minor carp, *Puntius sarana* (Hamilton). It is therefore the objective of this study to determine the metabolic rates, respiratory quotient and ammonia quotient (RQ and AQ—volume of CO_2 produced/ volume of O_2 consumed and volume or mole : mole relations of NH_3-N excreted to O_2 consumed respectively) during random (spontaneous) activity. Under aerobic conditions random activity did

not appear to have any effect on the RQ, but the AQ might change with random activity (Peer Mohamed 1974, Kutty & Peer Mohamed 1975 and Peer Mohamed 1982). The tests were made at 30° and 35°C; the high temperatures were chosen because of the paucity of information of fish energetics at these temperatures and also because of their local conditions. In mullet, *Rhinomugil corsula* (Kutty & Peer Mohamed 1975) and cichlid, *Tilapia mossambica* (Peer Mohamed 1982) it has been reported that the metabolic rates and quotients did not change at 30° and 35°C.

Materials and Methods

Specimens of *P. sarana* were collected from local freshwater ponds and acclimated separately at 30° and 35°C for at least 15 days before tests. Fish were fed *ad lib* with a formulated food (Hariharan 1973). Before test, fish were starved for 36 hr and subsequently left in the respirometer overnight. Tests were performed at the temperature of acclimation.

The apparatus used was a modification of Fry's respirometer (Kutty et al. 1971a) in which simultaneous measurements of metabolic rates and random activity can be made. Decarbonated water, adjusted to a *p*H of 8.2, was used as explained in Kutty et al. (1971 b) and recirculation of water through the respirometer was also maintained (Kutty & Peer Mohamed 1975). The experimental procedure followed was as described in Kutty and Peer Mohamed (1975) with open and closed periods.

Dissolved oxygen was measured by using unmodified Winkler technique (APHA 1965). Maros-Schulek technique (Maros et al. 1961), modified for fish metabolism studies by Kutty et al. (1971b), was followed for the determination of total carbon dioxide. Ammonia was measured by the method of Stroganov (1962) as described by Kutty (1972).

Results

Routine O_2 consumption, CO_2 production, NH_3–N excretion, RQ and AQ against random activity of *P. sarana* (21.7 g and 22.3 g body weight) acclimated to and tested at 30° and 35°C respectively at ambient oxygen concentration near air saturation are graphically shown in figure 1. The present plots for *Puntius* are simple plots through which a single straight line could easily be fitted (table 1).

The routine and standard metabolic rates (O_2, CO_2 and NH_3–N) at 35°C are higher but the metabolic quotients (RQ and AQ) are remarkably close to each

Table 1 *Regression equations* ($\log Y = a + bX$) *of metabolic rates and quotients* (Y) *against random activity* (X) *in P. sarana*

Metabolic rates/quotients	30°C	35°C
O_2 consumption (ml/kg/hr)	$\log Y = 1.75887 + 0.00171\ X$	$\log Y = 1.89623 + 0.00072\ X$
CO_2 production (ml/kg/hr)	$\log Y = 1.61499 + 0.00301\ X$	$\log Y = 1.80755 + 0.00196\ X$
NH_3–N excertion (ml/kg/hr)	$\log Y = 0.63256 + 0.00250\ X$	$\log Y = 0.75892 + 0.00207\ X$
Respiratory quotient	$\log Y = -0.14614 + 0.00143\ X$	$\log Y = -0.07882 + 0.00113\ X$
Ammonia quotient	$\log Y = -1.12884 + 0.00085\ X$	$\log Y = -1.12200 + 0.00108\ X$

other at both the temperatures. Similarly the extrapolated standard values except RQ and AQ differ from metabolic rates, higher at 35°C. Analysis of data by applying *t*-test indicated that the regression coefficients of metabolic rates and quotients at 30° and 35°C are not significantly different ($P > 0.05$), suggesting that the temperature difference (30°–35°C) does not seem to cause a marked difference per change in unit effort—random activity—in *P. sarana*.

Discussion

In the results presented, a positive correlation between metabolic rates/quotients and random activity is noted (table 1). The regression lines of O_2 consumption and CO_2 production at 30° and 35°C (figure 1) are almost parallel, suggesting no change in RQ with changes in random activity which is in agreement with the observations made earlier on goldfish and rainbow trout (Kutty 1968), *R. corsula* (Kutty & Peer Mohamed 1975) and *T. mossambica* (Peer Mohamed 1982). The mean routine RQ of 0.8 at both the temperatures, a value which implies a normal balance in the sources* from which energy is derived. The NH_3-N excretion plots showed positive trends, likewise that of AQ at both temperatures thereby, suggesting that increase in random activity was associated with higher AQ i.e., the more active the fish, the proportionately higher its protein use and/or higher involvement of protein degradation. There is also a variance in the results of study on the relationship of random activity on AQ which decreased with increase in activity (Kutty & Peer Mohamed 1975 and Peer Mohamed 1982). It has also been reported that AQ increased during the increase in forced activity (Kutty 1972, Karuppannan 1972 and Sukumaran & Kutty 1977) and it has been suggested that in this case there might be a protective action of carbohydrates on proteins (Phillips 1969). But from the present results, eventhough it is obvious that protein degradation and utilization could be higher during the increase in random activity, as indicated by NH_3-N excretion, there is possibility of involvement

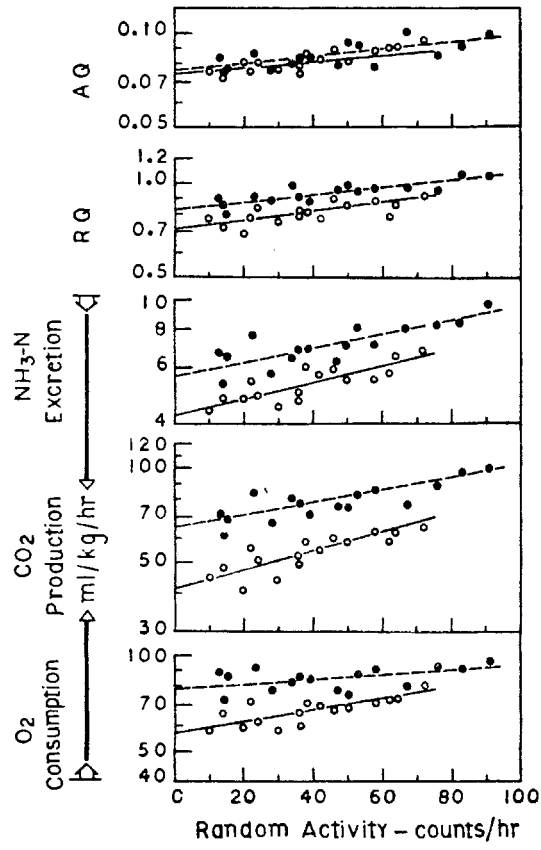

Figure 1 O_2 consumption, CO_2 production, NH_3-N excretion, RQ and AQ in relation to random activity in ***Puntius sarana*** acclimated to and tested in air saturated water at 30° and 35°C. Data for 30° and 35°C are indicated by open circles and solid circles and regression lines by solid lines and dotted lines respectively.

*RQ = 1.0 for carbohydrate, 0.71 for fat, and 0.81 for mixed protein (Blaxter 1965)

by other substrates also. If AQ is below the aerobic maximum of 0.33 (Kutty 1978) (mean AQ=0.08 and 0.085 at 30° and 35°C respectively in the present study) it suggests involvement of other substrates, thus reducing the relative contribution of protein catabolism in energy release. At an AQ of 0.08 (30°C) and 0.085 (35°C), an estimated 24% ($0.08 \times 100/0.33$) and 27% ($0.085 \times 100/0.33$) of the total oxygen consumed was used for oxidising proteins; the remaining 76% and 73% was accounted for by carbohydrates and/or fats,

At 'zero' activity (extrapolated value) an upward shift in metabolism is well marked at 35°C (figure 1) which are 37, 56 and 33% for O_2, CO_2 and NH_3-N, and 17 and 3% for RQ and AQ respectively. This shift in turn suggests that the metabolism is temperature dependent in *P. sarana*. In *R. corsula* (Kutty & Peer Mohamed 1975) and *T. mossambica* (Peer Mohamed 1982) the increase of 5°C (30°–35°C) did not influence much on metabolism.

The prime importance of the present observations lies in the fact that the results are more acceptable and provides an insight into the metabolism especially on RQ and AQ which are the indices of sources of energy utilization.

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