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Effect of Salinity & Time of Exposure to Air on the Metabolism of Green Mussel, *Mytilus viridis* L.*

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—Total oxygen consumption of *M. viridis* was higher in 100% (salinity, 35‰) sea water. Increase in metabolic rate after exposure was found to be a function of duration of exposure. Extra energy needed during post-exposure period was also calculated. —

SALINITY is one of the major environmental variables, which influences the metabolism of estuarine organisms. Effect of salinity on metabolism of marine and estuarine invertebrates is less documented than that of temperature[1-4]. While much work has been done on the respiratory metabolism of mussels of temperate region[5-9], nothing is known about the tropical Indian green mussel, *Mytilus viridis* L. *M. viridis* grows extensively in the Ennore Estuary, Madras, where salinity reaches 18‰ in monsoon months of October-December and near 35‰ is prevalent in rest of the year[10].

Collection and maintenance of animals — All mussels were collected from Ennore Estuary during June-August 1974. Individual mussels were separated from clumps in the laboratory, scrubbed with a wire brush to remove fouling organisms and cleaned in sea water. The animals were maintained in aquaria under experimental temperature and in salinities of 100%, 75% and 50% sea water for a period of 3 weeks (100% sea water having the salinity of 35‰). Sea water was diluted with distilled water to make up the required salinity. Experimental organisms were fed with algae *chlorella* sp. on alternate days, but starved for 24 hr prior to the experiment as suggested by Weigert[11]. Live specimens weighing 0·14 to 84·8 g (moisture content 67%) were used in the experiment.

Metabolic rate measurements — Closed respiratory chambers of 500 ml and 2 l capacity similar to those used by Mathew and Sumithra[12], were used in these experiments, as per the size of the mussels. Respiratory chambers were immersed in a water bath maintained at 28·2° ± 1°C. Only sea water filtered through No. 25 silk was used in these experiments. Each experiment was conducted for a period of 3 to 5 hr. Since the animals were found to reach the normal state from excitement by 30 min, they were acclimated to the chambers 30 min before starting the initial reading. Oxygen estimations were made by Winkler method as per Strickland and Parson[13]. Oxygen consumption values were expressed in µl/hr. The tissues of the mussels were dried to a constant weight in an hot air oven kept at 80°C.

Metabolic stress on mussels as a function of exposure duration under conditions of pre- and post-exposure was obtained for the mussels. In this study the mussels were allowed to attach to the floor of the experimental chambers overnight. After recording the initial oxygen consumption, the water was drained of the containers and the mussels were subjected to exposure for 6 and 12 hr. Later, water was replaced in such a way as not to disturb the animals and oxygen consumption readings were taken at an interval of 30 min. Control animals were allowed to remain submerged throughout the period. In this study sea water of 35‰ salinity was used and the mussels taken were of uniform size (0·987 g dry weight). The metabolic studies were conducted at 28·2° ± 1°C. In studying the post-exposure energy demand 1 µl O_2 was taken as equal to 48×10^{-4} cal as per Ivelev's deduction[14].

Salinity and metabolism — The formula $Y = aX^b$, where Y is the total oxygen consumption, X the body weight, a the regression coefficient and b the exponent, has been applied to the data of the oxygen consumption values for mussels of different weights in the 3 saline waters. Total oxygen consumption holds a linear relationship with dry body weight of the organisms on a double logarithmic grid (Fig. 1). Table 1 shows the date of collection, salinity, experiment and the fitted a and b values for oxygen consumption at the 3 experimental salinities for the experiments with the 95% C.I.

Oxygen consumption is higher in 100% sea water than in 50% (Table 1). The present study is in conformation with the findings of Bohle[15] who in his studies on *M. californianus* has reported higher rates of filtration and growth in 100% sea water than in 75% and 50%.

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TABLE 1 — TEMPERATURE, SALINITY, DATE OF COLLECTION OF THE ORGANISMS AND a AND b VALUES ±95% C.I. FOR VARIOUS OXYGEN CONSUMPTION EXPERIMENTS

Experiment at 28·2° ± 1°C in sea water %	Date of collection	Field temp. °C	Field salinity %	n	a ± 95% C.I.	b ± 95% C.I.
100 (35% salinity)	1 June '75	27·8	34·34	28	0·817 ± 0·3052	0·7001 ± 0·1138
75 (26·25% salinity)	1 July '75	28	34·54	37	0·2621 ± 0·1528	0·8547 ± 0·1474
50 (17·5% salinity)	1 August '75	28	33·67	45	0·0861 ± 0·1166	0·8996 ± 0·0436

TABLE 2 — METABOLIC RATE ±95% C.I. OF *M. viridis* WITH A MEAN DRY BODY WEIGHT OF 0·987 g AT 28·2°±1°C DURING PRE- AND POST-EXPOSURE PERIODS

[Number of experiments are 10]

Mussels	Metabolic rate (µl/g/hr)			
	Pre-exposure 30 min	Post-exposure		
		30 min	60 min	90 min
Control	800±11·2	—	—	—
Exposed for 6 hr	820±10·93	1200±12·19	900±11·18	800±11·1
Exposed for 12 hr	850±18·17	1800±22·1	1000±12·1	700±8·2

The *b* values for oxygen consumption are within 1 to 0·68 range as expressed by Zeuthen[16] which cover most of the organisms. These values are also in close agreement with the general *b* value for poiklotherms of 0·75 as proposed by Hemmingsen[17] based on large number of species. It can also be noted that *b* values increased from 0·7001 to 0·8996 while *a* values decreased from 0·817 to 0·086 following the decrease in metabolic activity. Sundaram and Shafee[18] have noted in *M. viridis* a slow decrease in byssus formation and activity below 50% sea water (salinity 17·5%).

Time of exposure to air and metabolism — M. viridis which lives in eulittoral zone, experiences exposure to air of varying duration in accordance with the tidal rhythm. The rates of oxygen consumption were studied in sets of animals of equal size, which were exposed for 6 and 12 hr. Table 2 shows metabolic rates of these animals during pre- and post-exposure periods. Mean values are significantly different with 95% C.I.

In the present study, a spurt in oxygen consumption is noted during the post-exposure period. Increase in metabolic rate is directly proportional to the duration of exposure. The mussels take 1½ hr to reach metabolic normalcy equal to that of control animals and after this time the animals show no change in metabolic rate during the experimental period. The energy expenditure is calculated from the oxy-calorific coefficient. While the control animals spend only 5·56 cal in 1½ hr, the animals exposed for 6 and 12 hr need 7·49 and 8·4 cal respectively. The post-exposure energy demand of 1·93 cal for 6 hr exposed mussels and 2·84 cal for 12 hr exposed mussels show clearly the strain on the animal in relation to the duration of exposure.

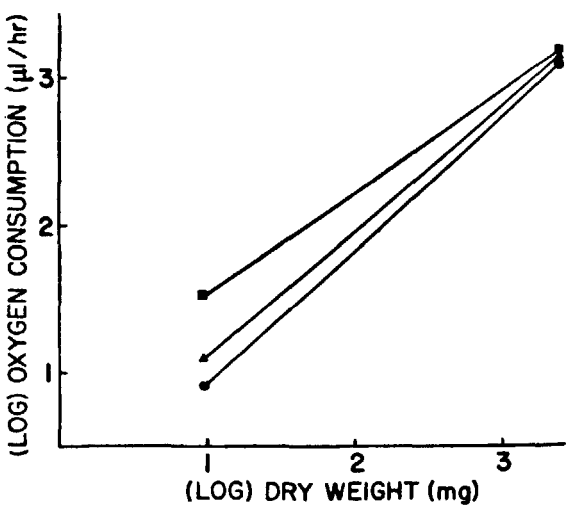

Fig. 1 — Oxygen consumption of mussels at 3 different salinities (temperature: 28·2°±1°C) plotted against dry body weight [■, 100% sea water; ▲, 75% sea water; ●, 50% sea water]

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