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EFFECT OF TEMPERATURE ON THE OXYGEN CONSUMPTION OF THE ASIATIC CLAM *Corbicula fluminea* (Muller) FROM GARMAT ALI RIVER, BASRAH, IRAQ.

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SUMMARY

The oxygen consumption was measured for the *Corbicula fluminea* clam at four different temperatures 15-30 C° by using Winkler method. Oxygen consumption per individual increased linearly with increasing weight on a log basis. The regression lines for the four experimental temperatures differed significantly and their slopes varied from 0.6663 to 0.7982. Individual respiration rates showed an increase with increasing temperature. Mean oxygen consumption rates for the eight size classes ranged between 1.501 and 96.612 (μlO_2/ indiv/h). Mean temperature coefficient (Q_{10}) of this clam was higher at the lower temperature range (15-20 C) than the higher one (25-30 C).

INTRODUCTION

The corbiculidae has had a relatively short fossil history. This family appeared in estuarine fauna in the middle to late Jurassic, with *Corbicula* occurring in freshwater only in recent times (Keen and Casey, 1969). The asiatic clam *Corbicula fluminea* (Muller) was first reported in Pacific Northwest at the turn of century (Burch, 1944, Counts, 1981) and has since spread each ward, becoming a dominant benthic invertebrate (in biomass) in many of the majer drainage basis in the United state (Mattice, 1979). *C. fluminea* is a common eulamellibranch pelecypod in the intertidal and subtidal areas of the Shatt Al-Arab river system including Garmat Ali river. Abdul-Sahib *et al.* (1995) studied the monthly changes in density and secondary production of the clam *C. fluminea* togather with other clam *C. fluminalis* at the same studied area. Marine subtidal, intertidal and freshwater bivalve mollusks disply different responses to exposure in air. Emersed subtidal species keep the valves shut and remain anaerobic (Dugal, 1939) whereas most intertidal species remaine aerobic by exposing the mantle tissues directly to air through gaped valves with parted mantle edges (Lent, 1968; Coleman, 1973) or through open siphons (Boyden, 1972). Mcmahon and Williams (1984) described the oxygen consumption associated with mantle – edge exposure in emerged speciments of *C. fluminea* and discuses the adaptive significance of the species unique mode of aerial respiration. The relationship between oxygen consumption and dried tissue weight and effect of different water temperatures on the respiration of the clam *C. fluminalis* were studied by Abdul –Sahib *et al.* (2000). This paper describes the effect of different water temperature on the oxygen consumption rates and metabolic rates of the clam *C. fluminea*.

METHODS

Speciment of *Corbicula fluminea* were taken from a subtidal population of Garmat Ali river Shatt Al-Arab for the period from February to July 2000. They were carried immediately to the laboratory. To insure complete acclimation the animals were maintained at their respective temperatures for two weeks in the incubator under constant photoperiod of 12 hours at each of the four experimental temperatures (15, 20, 25 and 30 C) .Winkler method was used for the determination of the dissolved oxygen concentrat . This method has been the subject of many modifications to reduce the errors, improve the accuracy by better titration and to adept it to very small volumes of water (Lampert, 1984). The clams were starved for 1-2 days before the start of each experiment, and were kept in a series of 6o ml glass container (1-2 individuals were shell measured in each) merged in fresh aerated water. A burett of 0.01 ml accuracy was used for titration. Dry tissue weight were estimated from a log- log regression of shell length (mm) against dry tissue weight (mg) of clams dried at 60 C. The equation for this relationship was log weight = 2.8905 log length – 1.7498 (r = 0.98, n= 80). The relationship between oxygen consumption (μlO_2/indiv./h) and dry tissue weight (mg) was used as log R = log a + b log w and log (R/W) = log a + (b-1) log w for metabolic rate where R = oxygen consumption and w = dry tissue weight (Crisp, 1984).

In order to investigate the differences further, an analysis of covariance and student newman kuel's test were undertaken, Q_{10} (temperature coefficient) was calculated for the range of temperatures from 15 to 30 C based on the equation $Q_{10}=(V_2/V_1)^{10/(t2-t1)}$ where V_1 and V_2 are the velocities of the which process at temperatures t_1 and t_2 respectively (Grodzinski, *et al.*, 1975).

RESULTS

Oxygen consumption and dry tissue weight

The relationship between oxygen consumption ((μlO_2/indiv./h) and dry tissue weight (mg) was linear when plotted on a double basis at 15, 20, 25 and 30 C, Fig 1 shows this relationship for each of the four temperatures. The regression coefficients for the fitted lines, the correlation coefficients and the level of significance for the relationship between oxygen consumption, metabolic rate and dry tissue weight are given in Table 1. The main features of these results are the increase in oxygen consumption with increasing dry tissue weight and the decrease in metabolic rate with increasing size, at all

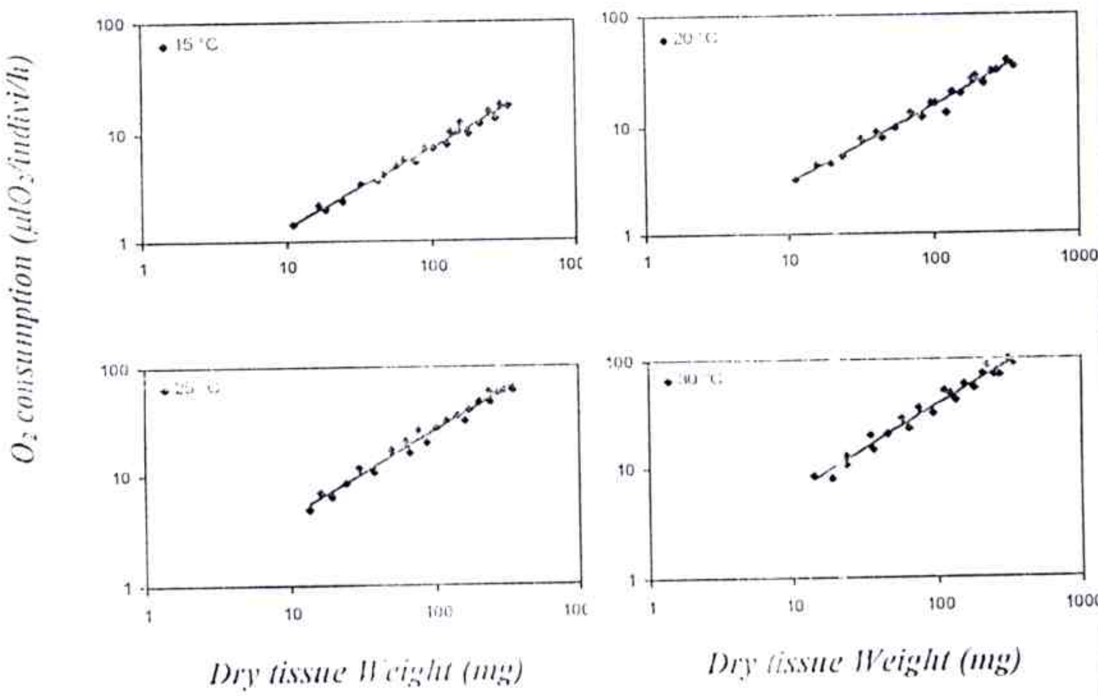

Fig.1 Relationship between rate of oxygen consumption and dry tissue weight on log-log basis for *C. fluminea* at four temperatures.

Table 1. Linear correlation between respiration rate, metabolic rate and dry tissue weight of *Corbicula fluminea* at four temperatures.

Temp (C)	a	b	r	n
	Respiration rate (μlO_2/ indiv/h)			
15	0.3195	0.6663	0.98	22
20	0.5864	0.7102	0.99	22
25	0.7214	0.7724	0.99	22
30	0.9415	0.7982	0.98	22
	Metabolic rate (μlO_2/ indiv/h)			
15	5.4750	-1.0145	-0.57	22
20	0.2789	-3.1404	-0.95	22
25	1.0520	-3.3171	-0.89	22
30	3.5954	-3.3022	-0.82	22

Table 2. Mean respiration rates for eight size classes of *Corbicula fluminea* at four temperatures.

Size classes (mm)	Mean dry weight (mg)	Respiration rate (μlO_2/ indiv/h)			
		15 °C	20 °C	25 °C	30 °C
9	10.196	1.501	3.051	4.335	6.008
12	23.419	2.612	5.508	8.241	11.667
15	44.636	4.014	8.708	13.562	19.523
18	75.608	5.703	12.662	20.375	29.733
21	118.055	7.674	17.375	28.745	42.432
24	173.665	9.924	22.856	38.729	57.741
27	244.103	12.451	29.108	50.377	75.771
30	331.009	15.252	36.137	63.737	96.612

Table 3. Van't Hoffs Q_{10} for three temperature ranges for eight size classes of *Carbicula fluminea*.

Size classes (mm)	Mean dry weight (mg)	Q_{10}		
		15-20 C	20-25C	25-30C
9	10.196	2.03	1.42	1.39
12	23.419	2.11	1.50	1.42
15	44.636	2.17	1.56	1.44
18	75.608	2.22	1.61	1.46
21	118.055	2.26	1.65	1.48
24	173.665	2.30	1.69	1.49
27	204.109	2.34	1.73	1.50
30	331.009	2.37	1.76	1.52

General mean of Q_{10} = 1.77

temperatures studied. The relationship between the four regression equation of oxygen consumption on dry tissue weight was examined by an analysis of covariance. It showed that the slopes of the four fitted lines were significantly different ($F = 15.18$ $p < 0.001$) and that the slops were not homogeneous.

A student Newman. Keuls multiple range test was used to determine which of the slopes differed significantly from the others. This test reverted statistical differences between each non adjacent pair. In addition overall mean oxygen consumption showed little increase with increasing temperature over the range 15-30 C.

Oxygen consumption and temperatures

Clams were grouped into eight size classes on the basis of their shell length. The mean oxygen consumption for each these size classes was calculated from oxygen consumption – dry tissue weight regression equation (Table 1) at each experimental temperature, the calculated rates of oxygen consumption for each of the eight size classes at the four temperatures are presented in Table 2. The mean oxygen consumption obviously increased with the rising of temperature and the increasing of body size where oxygen consumption of individuals (10.196 mg) were ranging from 1.501 ((μlO_2/indiv./h) at 15 C to 6.008 ((μlO_2/indiv./h) at 30 C and (331.009 mg) were ranging from 15.252 (μlO_2/indiv./h) at 15 C to 96.621 (μlO_2/indiv./h) at 30 C. The temperature coefficient (Q_{10}) was estimated for the clam at three temperature levels (15-20, 20-25 and 25-30 C). At the range from temperature 15-20 C, the Q_{10} values was ranging from 2.03 to 2.37 for eight size classes whereas the values were 1.42 to 1.76 and 1.39 to 1.52 for the same size classes at the temperatur ranges 20-25 C and 25-30C, respectively and general mean of Q_{10} 1.77 (Table 3).

DISCUSSION

One of the factors influencing clam respiration rate is the nature of the rate measured. A distinction should be made between unacclimated and acclimated rates, and whether resting, routine or active rates are measured (Newell, 1973). The rates presented in this work were routine rates, because clams exhibited slight movements inside the respiration glass containers. The respiration rate of *C. fluminea* was found to be increasing linearly with increasing dry tissue weight and metabolic rate decreased with increasing dry tissue weight. These result were in accordance with that of other clam. *C. fluminalis* (Abdul – Sahib *et al.*, 2000). The effect of body size on oxygen consumption was less for smaller animals than for larger ones. The oxygen uptake was an exponential function of the body weight (Ghiretti, 1966). Berry (1983) found that oxygen consumption in sea water increased with size and tissue weight in *Natica maculosa*. *C. fluminea*, being ectotherm., showed an increase in oxygen consumption with rising temperature and this has been demonstrated in prosobranches (Newell and Northcroft, 1967; Freiburg and Hazelwood, 1977) and Pulmonates (Daniels and Armitage, 1969). Burky (1971) showed that respiration rates of *Ferrissia rivularia* were highest during summer and spring. Oxygen consumption by *Thais lapilius* varied seasonally with higher values in summer that in winter (Bayne and scallard, 1978). Fitch, (1975) found that respiration coefficients were affected by activity level and time of day. The response of *C. fluminea* to temperature changes (Q10) showed a slight, increase with increasing body size. This indicates that *C. fluminea* of different sizes react similarly to temperature change. General mean of Q_{10} value for eight size classes was 1.77, Newell (1973) concluded that respiration rate in a wide variety of ectotherms is temperature dependent with a Q_{10} value of approximately 2.

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تاثير درجات الحرارة على استهلاك الاوكسجين في المحار *Corbicula fluminea* في نهر كرمة علي

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البصرة – العراق

الخلاصـــــة

قيس معدل استهلاك الاوكسجين للمحار *Corbicula fluminea* في اربعـــة درجــات حرارية مختلفة (15، 20، 25 و 30 م) باستخدام طريقة ونكلر، أظهرت معدلات استهلاك الاوكسجين لافراد المحار زيادة خطية مع الوزن الجاف للدرجات الحراريـــة الاربعــة وتراوحت بين 0.6663 في درجة حرارة 15م و 0.7982 في درجة حـــرارة 30 م. كمــا لوحظ ان هناك زيادة في معدلات تنفس افراد المحار مع زيادة درجة الحرارة. تراوحــت معدلات استهلاك الاوكسجين لثمانية مجاميع حجمية بيـــن 1.501و 96.612(μlO_2/indiv/h) في د رجة حرارة 30م معدل المعامل الحـــراري Q_{10} لاســتهلاك الاوكســجين للمــدى الحراري المنخفض 15-20 م كان اعلى من المدى الحراري المرتــفع 25-30م .