RESEARCH PAPER:

Effect of temperature on the oxygen consumption of freshwater female crab, *Barytelphusa guerini*

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SUMMARY

Metabolic response to thermal stress and its relation to size were studied in the crab by determining the temperature characteristics of oxygen consumption in the temperature range of 10º C to 37 ºC. The fresh water female crab, *Barytelphusa guerini* was selected for present investigation. It is abundantly available in the paddy fields of Nanded district. The crustaceans were collected from their natural habitat and brought to the laboratory to acclimatize them with laboratory condition. The animals were acclimated to different temperatures in the temperature bath. The total oxygen consumption and rate of oxygen consumption per unit body weight was studied by modified Winkler's Method. In the present work, total oxygen consumption and rate of oxygen consumption showed gradual increased trend at higher temperature and at lower temperature decreased as compared to control.

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Key Words : Temperature, Acclimation, Oxygen consumption, *Barytelphusa guerini*

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Temperature limits the distribution of animals, it affects the metabolic activities (Mc Whinn; 1967). In general, life activities occur within a range of about 0 ºC to 45 ºC. However, most animals live within much narrower limits. The effects of temperature on the metabolism of poikilotherms are elucidated through studies on oxygen consumption in relation to thermal stress, seasonal variations, temperature acclimation in the laboratory and natural adaptation of animals to wide geographical areas occurring at different latitudes.

The metabolic rate of crustaceans is generally related to temperature as in other poikilotherms (Precht *et al.,* 1955; Wolvekamp and Waterman; 1960). In cold blooded animals, the oxygen consumption rises with increasing temperatures but rise does not proceed at uniform rate for all ranges of temperature. The temperature limits the rates of chemical reactions which depends upon the effect of temperature on the previous thermal history of the animal (Prosser and Brown,1961), the manner in which the animal is exposed to a temperature stress which is an important factor for the determination of respiratory rate in animals.

On several investigations, it is concluded that the rate of physiological processes, determined at various temperatures with the velocity of chemical reactions occurs *in vitro.*

The chief aim of the present study was to investigate the oxygen consumption in the freshwater female crab, *Barytelphusa guerini* under different temperature conditions. The metabolism of poikilothermic animals is a complex physiological process which shows the effect of temperature on the oxygen consumption of freshwater female crab, *Barytelphusa guerini*. The factor i.e. temperature influences the respiratory metabolism of animals.

The investigation shows that the physiological activities involving respiratory exchanges tend to fall within a certain definite order of temperature characteristics (Crozier, 1924).

EXPERIMENTAL METHODOLOGY

The freshwater female crabs, *Barytelphusa guerini*, used in the present investigation were collected from the paddy

fields and were brought to the laboratory. The animals were acclimated in the laboratory condition for six days and used for experimentation. The healthy female crabs weighing between 40-45 g were selected for experimentation to avoid the effect of sex and size (Ambore, 1976). The animals were feed with small pieces of goat muscles to avoid the effect of starvation. Water in the reservoir and the animal chamber was maintained at the required temperature during the course of experimentation. Measurement of oxygen consumption was started at lowest temperature (10º C) and successive measurements were made at the increasing temperatures with an interval of 10º C up to 37 ºC. As the temperature of 40 ºC was found to be lethal, the highest temperature studied was 37 ºC. Temperature was changed gradually and stepwise as it was proved to be more effective in determining the magnitude of the thermal stress. The animals were kept in temperature bath for one hour at various temperatures. The respiratory metabolism was studied by modified 'Winkler's Method' (Welsch and Smith, 1959). The control set also designed to compare the respiratory metabolism with different temperatures. The set designed by Saroja (1959) was used to determine the oxygen consumption. Specialized respiratory chamber was used which was black coloured glass bottle facilitated by inlet, outlet and control openings. After taking all precautions about respiratory chambers, a medium sized animal was kept in airtight respiratory chamber by paraffin wax and initial water sample was collected. The animal was allowed to stay in the chamber for 1 hr and at the end, the final sample was collected. By this method, oxygen consumption in initial and final water samples was determined and the difference between the two readings was the amount of oxygen consumed by animal during 1 hr.

EXPERIMENTAL FINDINGS AND DISCUSSION

The freshwater female crab, *Barytelphusa guerini* showed variations in total oxygen consumption and rate of oxygen consumption when exposed to different temperatures. In the present investigation, it showed that the rate of oxygen consumption increased with increasing temperature as compared to control. The results were presented in Table 1 and Fig.1 and 2. for total oxygen consumption and rate of oxygen consumption.

The results obtained (Table 1) indicate that the total oxygen consumption of *Barytelphusa guerini* decreased at 10 ºC, 15 ºC, 20 ºC as compared to control. But as the temperature increased the total oxygen consumption was found to increase at 25 ºC, 30 ºC, 37 ºC. The temperature of control set was 22 ºC. Similar results were found to be

Table 1 : Changes in O_2 Consumption and at of O_2 consumption at different temperatures in crab

Sr. No.	Temperature maintained (in ºC)	Total oxygen consumption (CC of O_2/animal/hr)	Rate of oxygen consumption (CC of O_2/g/hr/wt)
1.	22 ºC (Control)	2.543 ± 0.0030	0.0574 ± 0.03
2.	10 ºC	2.409 ± 0.11	0.0547 ± 0.007
3.	15 ºC	2.494 ± 0.003	0.056 ± 0.01
4.	20 ºC	2.514 ± 0.014	0.0570 ± 0.00
5.	25 ºC	2.550 ± 0.005	0.0578 ± 0.037
6.	30 ºC	2.66 ± 0.005	0.0604 ± 0.004
7.	37 ºC	2.79 ± 0.016	0.0628 ± 0.04

in rate of oxygen consumption at different temperatures.

The rate of oxygen consumption at 10 ºC was 0.0547, at 15 ºC 0.056, at 20 ºC 0.0570, at 25 ºC 0.0578, at 30 ºC 0.0604, and at 37ºC 0.0628 and that of control was 0.0574. The rate of oxygen consumption decreased from 10 ºC to 20 ºC and increased from 25 ºC to 37 ºC comparable with that of control set.

It has been reported that oxygen consumption represents the physiological state of metabolic activity and may be an indicator of metabolic stress. The environmental factors may induce stress to exposed animals (Dong *et al.,*2006 ; Newell, 1973; Ramamurthi,

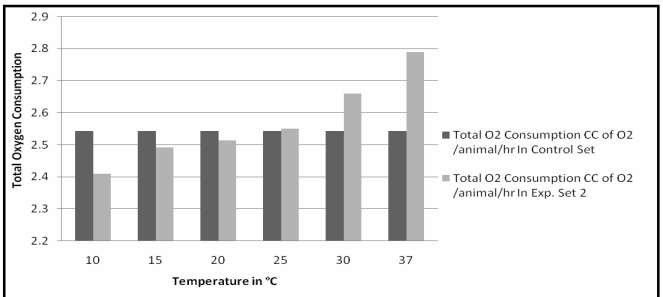

Fig. 1: Changes in O_2 consumption and rate of O_2 consumption at different temperatures in crabs, *Barytelphusa guerini*

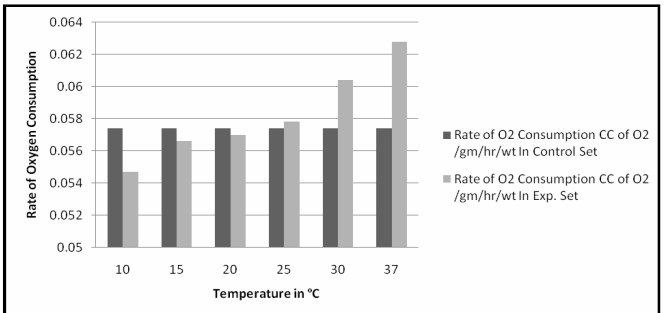

Fig. 2: Rate of oxygen consumption at different temperatures in *Borytelphusa guerini*

1967). Similar results were observed by many workers on the effect of temperature on oxygen consumption in freshwater female crab, *Barytelphusa guerini* (Saroja, 1959; Vernon, 1895, Wilson, 1972).Though the total metabolism in the crab increased with increasing environmental temperature as in other crustaceans (Paul, 1960, Rajabai, 1963; Marsden, 1973). This increase was uniformly lesser with arise in environmental temperature suggesting that the animals were more responsive to temperature changes at lower range of temperature while their sensitivity decreased at higher temperatures. The decline in the rate of oxygen consumption in lower temperature as compared to control may be the result of formation of coagulated mucous over the gills and boy surface of the crab (Mali and Ambore, 2003; Venkatachari and Ambore, 1979; Venkatachari and Kadam, 1974).

Thus, the temperature characteristics for the oxygen consumption in the crab seem to be influenced by the type of stress. This is more significant in view of the attempts to acclimatize the animals to various temperatures under laboratory conditions.

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