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Research Article

Temperature stress on biochemical constituents in *Barytelphusa guerini*

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ABSTRACT

The present investigation emphasizes on the variations in the levels of biochemical constituents on exposure to varying water temperatures in fresh water crab, *Barytelphusa guerini*. The crabs were divided into three experimental groups consisting of six crabs each for stress treatments and the crabs were maintained at the temperature (26 ^{0}C) which served as the control. Group-I: This experimental group was exposed to 22 ^{0}C for two hours. It referred to as a cold condition. Group-II: This experimental group was exposed to 26 ^{0}C for two hours. It referred as a normal condition. Group-III: This experimental group was exposed to 30 ^{0}C for two hours. The influence of temperature on tissue (muscle & hepatopancreas) protein, carbohydrate metabolites of crabs were shown to be changed. Higher temperature of 30 ˚C was found to have pronounce effect on the protein levels. Minor variations in the level of carbohydrates were observed under warm and cold stress. In the present investigation, the altered results obtained were demonstrated that the high and low temperatures influenced biological responses of *Barytelphusa guerini* and modulated its biochemical parameters (protein, carbohydrates) in order to cope with temperature.

1. Introduction

Temperature is an environmental factor that places a key role in determining animal distribution in the nature. Eurythermal crustaceans survive seasonally, but any diurnal or tidal changes in environmental temperature, develop resistance adaptations to change their behavior, physiology, growth and metabolism. Temperature is known to effect the chemical composition of aquatic organisms Landu and Brown *et al*. [1-2]. Bergar and Emlet [3] have also shown that acclimation of *Balanus glandula* to relatively higher temperatures resulted in higher levels of protein synthesis. A mechanism facilitating the release of oxygen at cell level linked with O_2 demand at the cost of increased in protein synthesis have also been reported. A comprehensive study of the aquatic poikilotherms in relation to thermal acclimation has been proposed to investigate the effect of cold and warm temperatures on the biochemical in order to observe the changes in the metabolic profiles which enable us to arrive at a clear understanding of the biochemical of fresh water male crab, *Barytelphusa guerini.* The aim of the present study was to evaluate whether temperature can effect biochemical parameter activities in an ecologically and economically important crab species.

2. Material and Methods

2.1 **Collection and maintenance:** Adult fresh water crabs, *Barytelphusa guerini,* were caught from Ramnagar fish market of Hyderabad, Telangana, India. The crabs were transported to the laboratory in aerated plastic troughs. They were weighed and acclimatized for a week in tanks containing 10-15 cm of sand at the bottom, at room temperature. The water was removed and dechlorinated tap water was introduced daily.

2.2 **Temperature Exposures:** The crabs were divided into three experimental groups consisting of six crabs each for stress treatments and the crabs were maintained at the temperature (26 ^{0}C) which served as the control. **Group-I:** This experimental group was exposed to 22 ^{0}C for two hours. It referred to as a cold condition. **Group-II:** This experimental group was exposed to 26 ^{0}C for two hours. It referred to as a normal condition. **Group-III**: This experimental group was exposed to 30 ^{0}C for two hours. It referred to as a warm condition. Immediately after thermal incubation, all the experimental crabs were placed in the dechlorinated water with ambient temperature. After 2 hours, the thermal incubation was terminated, then muscle and hepatopancreas tissues were collected from the crabs for experimentation.

2.3 **Quantification of biochemical analysis:** The biochemical composition of the muscle, hepatopancreas in the experimental groups' recovery was studied following standard biochemical procedures. Estimation of proteins

was done as for the methodology of Lowry *et al.*, 1951. Estimation of carbohydrates was done according to the methodology of Roe, 1955.

2.4 **Data analysis:** The results of the present investigation, enumerating the effect of varying temperatures on the biochemical constituents (proteins, carbohydrates) were expressed as Mean ± SD by performing student's **t**-test ($P<0.05$).

3. Results and Discussion

3.1 Chemistry

The influence of different temperatures on biochemical contents in the tissues (muscle and hepatopancreas) of fresh water crab, *Barytelphusa guerini* was investigated and following results were found. All the levels were significant at $p<0.05$. The results are presented in figure-1.

From the data given in figure-1, it is clear that protein content in crabs muscle decreased significantly in cold temperature and increased significantly in warm condition. Carbohydrate values were decreased in cold temperature and increased in warm condition when compared to normal temperature.

The physiological mechanisms limiting and adjusting cold and heat tolerance have regained interest in the light of global warming and associated shifts in the geographical distribution of ectothermic animals. In accordance with shelfords law of tolerance decreasing whole animal aerobic scope characterizes the onset of thermal limitation at low and high temperature thresholds shelford[4]. A moderate change in ambient temperature can lead to vital physiological and biochemical adjustment in ectoderms.

A significant depletion in the carbohydrate content in the tissues (muscle and hepatopancrease) was observed in fresh water crab, *Barytelphusa guerini* exposed to cold and warm temperatures in the present investigation and it is supported by

Figure-1: Effect of temperature on muscle protein and carbohydrate levels in *Barytelphusa guerini* (n=6).

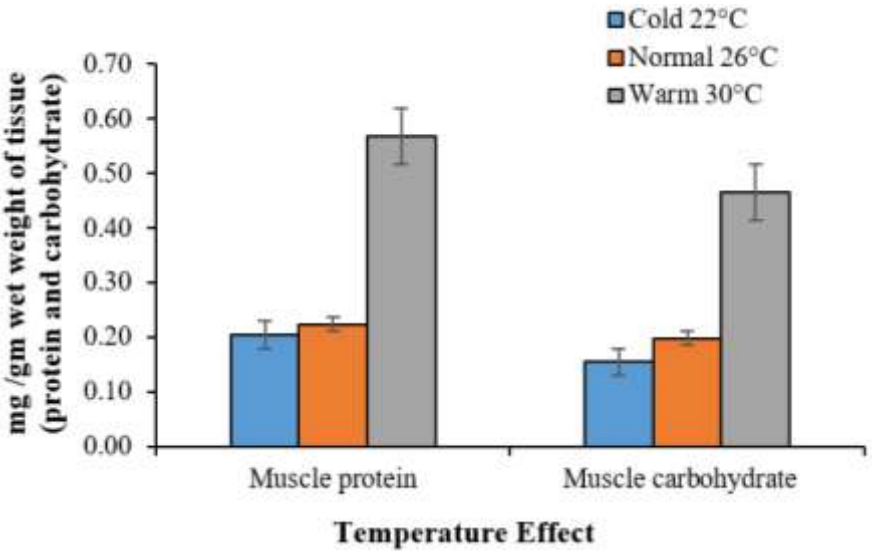
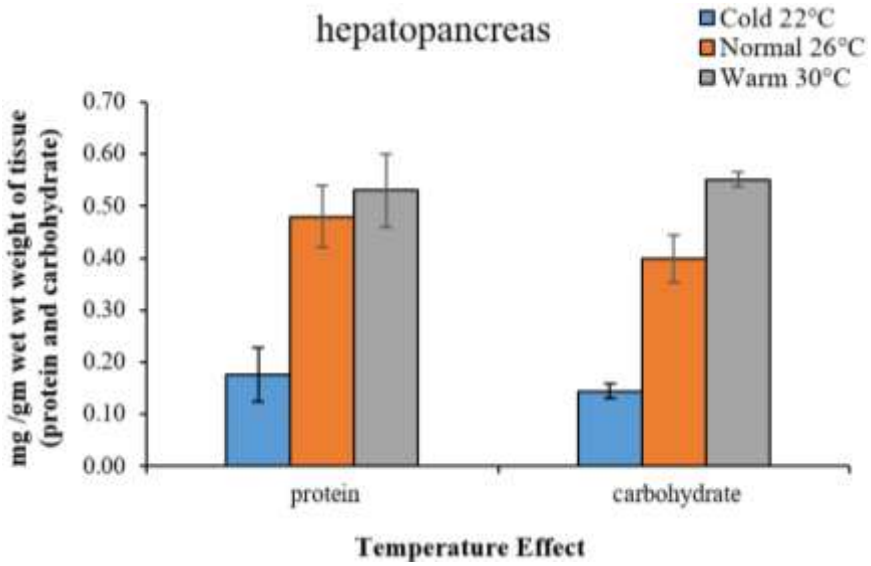


Figure-2: Effect of temperature on hepatopancreas protein and carbohydrate levels in *Barytelphusa guerini* (n=6).



the findings of Kulkarni and Nagabhushanm[5] and Krishnamurthy [6], who had briefed that the alteration in biochemical parameters to be eco-physiologically significant in counteracting the ambient thermal fluxes. Glucose being the predominant substrate in the energy yielding process, carbohydrate metabolism has been shown to play an important role in the energetic of thermal stress or adaptation Bonthu, [7].

Generally in poikilotherms maintenance of energy requirements are considerably lowered upon acclimation to cold temperature (Hochachka, P.W. and Somero, G.N.[8]. Considering the biochemical mechanisms in acclimation to be similar in different organisms, three possible modes of triggering and control are suggested by Rao [9] namely, direct effects of temperature, effects of the nervous system and most important of all, regulation through the release of hormones or hormone like substances. From the large number of studies carried out to date, it seems that animal cells utilize a multitude of volume regulatory mechanisms, including transport of inorganic and organic osmolytes across the cell membrane and alterations in metabolism to modify levels of organic metabolites (Lang, F., Busch, G.L.[10].

The influence of the different temperatures on hepatopancreas protein and carbohydrate levels of fresh water crab, *Barytelphusa guerini* was evaluated and results are shown in figure-2. All the volues more significant at $p<0.05$.

From the data given in figure-2, it is clear that protein content in crabs' hepatopancreas decreased significantly in cold temperature and increased significantly in warm conditions. Carbohydrate values were found to be decreased significantly in cold condition and increased significantly in warm temperature when compared to normal temperature.

Several metabolic pathways are sensitive to cell volume changes, including Glycogen synthesis and glycolysis, lead in to changes in the amount of carbohydrate metabolites that contribute to cellular osmolaty AI-Habori et al., [11]. It is known that the protein metabolism, just like carbohydrate or lipid metabolism, shows some adaptive changes in poikilotherms when exposed to thermal stress. Enhanced rate of general protein synthesis measured by the incorporation of labelled amino acids into proteins has been reported after cold acclimation in the liver of gold fish Das and Prosser,[12]. A significant increase in protein content in *Poecilobdella viridis* during warm and cold acclimation have been also reported by Kulkarni and Nagabhushanam [13]. In the present investigation, also similar significant increase in warm condition and decrease in cold condition in protein and carbohydrate levels were noticed in hepatopancreas of crab. Acclimation to higher temperatures resulted in higher levels of protein synthesis has been reported in *Balanus glandula* Berger and Emlet, [14].The recorded data of the present investigation indicated that the temperature had a role in maintaining normal physiological functions of the fresh water crab, *Barytelphusa guerini*.

4. Conclusion:

Further investigation emphasizing the importance of other relevant factors (e.g. seasonal amplitude of temperatures, food availability and activity levels of animals) are required when studying metabolic adaptations to temperature.

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Competing Interests

The authors have declared that no competing interests exist.

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