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RESEARCH ARTICLE

IMPACT OF THERMAL POLLUTION ON THE PROXIMATE COMPOSITION OF THE FRESHWATER PRAWN *MACROBRACHIUMROSENBERGII* IN METTUR FRESHWATER ECOSYSTEM

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ABSTRACT

Prawns contain good amount of organic and inorganic constituents. The major constituents are protein, carbohydrate and lipid. The proximate composition including moisture, fat and protein ash are good indicators of physiological condition of an organism. However, quantities of these constituents vary considerably within and between species with respect to size, sexual condition, feeding season and physical activity. In such an attempt, the present study was focussed to study the effect of thermal pollution on the proximate composition of the chosen tissues of the giant prawn,*Macrobrachiumrosenbergii*, collected from three different stations of Mettur freshwater ecosystem during various months from January to December, 2013. All the constituents were found to be higher at station III and lower at station I. whereas, the constituents were higher during the months January, February and March, 2013 and lower during April, May and June, 2013. Moisture (%) was observed to be the maximum component followed by protein (%) and lipid (%) was in the minimum level. The results were discussed in detail.

INTRODUCTION

Freshwater prawns are considered as the cheapest sources of nutrition for human consumption. The nutritional values of prawns depend on their major biochemical components such as proteins, carbohydrates and lipids. The greater the protein and lipid content represents higher the energy density (Dempson *et al*., 2004). However the above components vary considerably depending on the age, sex, seasonal variation, feeding season, physical activity and stress (Nargis 2006). It is also known that the tissue proteins, carbohydrates and lipids play a major role as energy precursors for prawn exposed to stress condition.The biochemical changes occurring in the body of prawns gives first indication of stress. During the stress an organism needs sufficient energy which is supplied from reserve materials like protein, lipid and glycogen. If the stress is mild, then only stored glycogen is used as a source of energy, but when the stress is strong, then the energy stored in lipid and protein may be used. The survival and productivity of freshwater prawn in pollutants however depend on their adaptability. Thus the proximate composition that includes moisture, fat, protein, carbohydrate and ash are good indicators of physiological condition of an organism.The increase in temperature of a natural body of water attributable to thermal effluents can have a very profound effect on the aquatic life in the body of water.

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High enough temperatures can cause direct mortalities of crustacean species and such high temperatures may adversely affect metabolic rates, reproduction and growth of aquatic life. Thus thermal pollution has come to mean the detrimental effects of unnatural temperature changes in the natural body of water, caused by the discharge of industrial cooling water (James, 1971).

It is thus very much required to learn the ecological effects of thermal discharges and the effects which may occur to the life processes in aquatic systems. At the present time, abiological indicator is not available for rating the overall effects of thermal effluents. Rather, a very limited number of species is investigated in the field and in the laboratory. *M.rosenbergii* is a giant freshwater prawn that has remarkable advantages, because of its omnivorous feeding habit, fairly high growth rate, attractive size, better meat quality and tolerance capacity (Ling, 1969). Prawns are frequently used as bio-indicators in environmental monitoring as the species tend to accumulate pollutants from their ambient habitat. Usually the level of pollutants accumulated in the tissues of prawns are used for assessing the level of pollution in their habitat (Abdullah and Moustafa, 2002). However, literature is scanty regarding the proximate composition of *M.rosenbergii* in the wild except a few reports (Cavilli *et al*., 2001; Thompson *et al*., 2004; Bhavan *et al*., 2008). Therefore in the present study, an attempt has been made to evaluate the proximate composition in the gill, hepatopancreas and muscle tissues of adult *M.rosenbergii*

collected from three different natural environments in Mettur freshwater ecosystem.

MATERIALS AND METHODS

Study area

The study was conducted taking Mettur thermal power station (MPS) as Centre which is located adjacent to the Mettur reservoir. Study points were fixed at distances of about 1.0 km (station I), 3.5 km (station II) in west and east directions respectively and at the main drain shutterpoint (station III).

Collection of samples

Healthy adult prawns were collected during early hours of the day from the three chosen stations with the assistance of the local fishermen. Collection was done on monthly basis from January to December, 2013. The collected samples were stored at 18^{o}Cforfavour of further analyses. The prawn samples were cleaned thoroughly, the exoskeleton was removed using sterilized forceps and the following tissues such as gill, hepatopancreas and muscle were dissected out and were subjected to biochemical analyses.The proximate composition of the tissues of *M.rosenbergii* was determined as per the AOAC,(1990) method.

Estimation of protein

The total protein content of the prawn tissues was identified by the method of Micro-Kjeldhal (Pearson, 1999) The values are expressed in % basis. protein (%) = % of total amount of N_2 X 6.25.

Estimation of lipids

The total lipid content of the chosen tissues of *M.rosenbergii* was estimated by theprotocol of Bligh and Dyer (1959). The values are expressed in % basis.

$$\text{Lipid\%} = \frac{\text{Weight of the extract}}{\text{Weight of the sample}} \text{X } 100$$

Estimation of moisture

The moisture content of the various tissues of the prawn *M.rosenbergii* was estimated using hot air oven method (Jain and Singh 2000). The pre weighed wet tissue samples were dried under 40^{0}C to measure the moisture content.The values are expressed in %

$$\text{Lipid\%} = \frac{\text{Weight loss}}{\text{Weight of the sample}} \text{ X } 100$$

Estimation of carbohydrate

The total carbohydrate content was calculated by difference. The total mass of moisture, total fat, ash and crude protein were subtracted from the whole mass of the tissues to yield the total carbohydrate content. The values are expressed in %.

RESULTS AND DISCUSSION

The protein content was maximum in the hepatopancreas and minimum in the gill tissues, irrespective of the stations and months studied. Among the stations, the tissues of *M.rosenbergii* collected from station III inhabited the highest protein content (Fig. 1).

One of the major requirements of prawn culture is the transformation of dietary protein into tissue protein. Protein is essential for normal function, growth and maintenance of body tissues. Its content is considered to be an important tool for the evaluation of physiological standards (Diana, 1982). Aminoacids are the building blocks of proteins and serve as body builders.

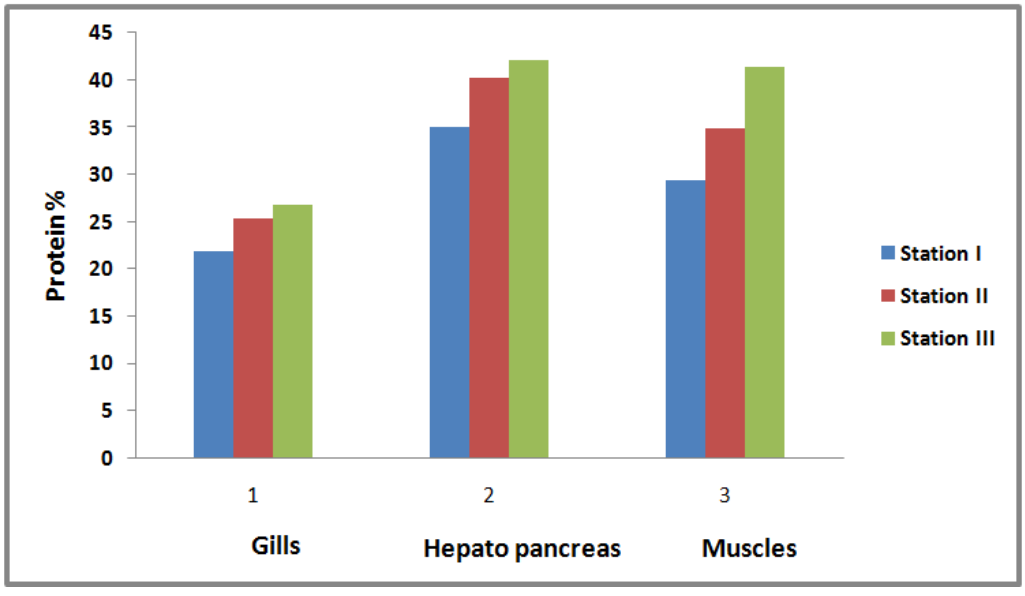

Fig.1. Protein Content in the gill, hepatopancreas and muscle tissues of *M.rosenbergii* collected from the stations I, II and III Mettur reservoir during April, May and June, 2013

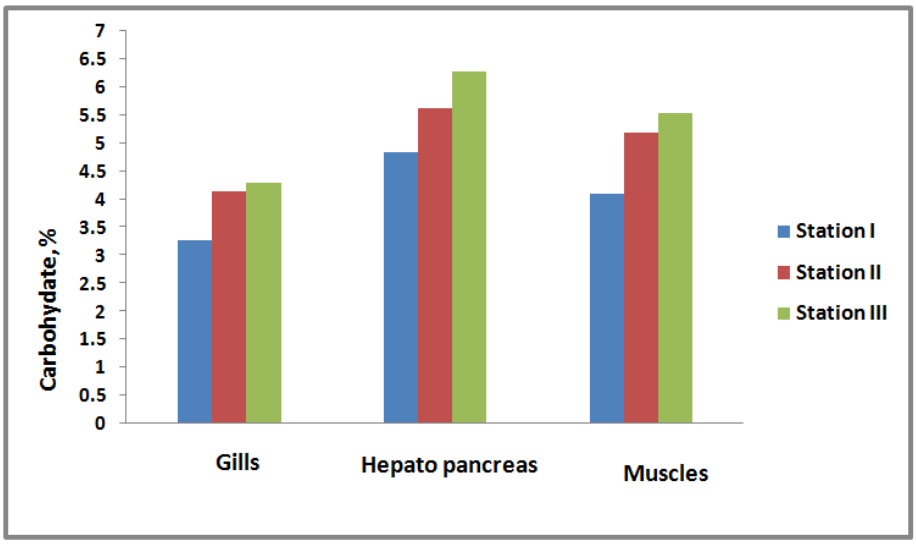

Fig.2. CarbohyerateContent in the gill, hepatopancreas and muscle tissues of *M.rosenbergii* collected from the stations I, II and III Mettur reservoir during April, May and June, 2013

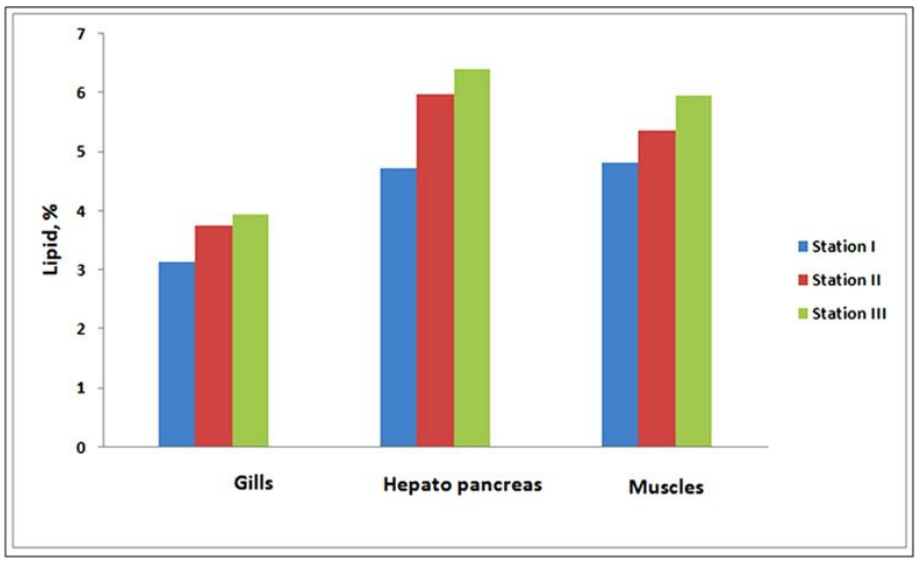

Fig.3. Lipid Content in the gill, hepatopancreas and muscle tissues of *M.rosenbergii* collected from the stations I, II and III Metturreservoir during April, May and June, 2013

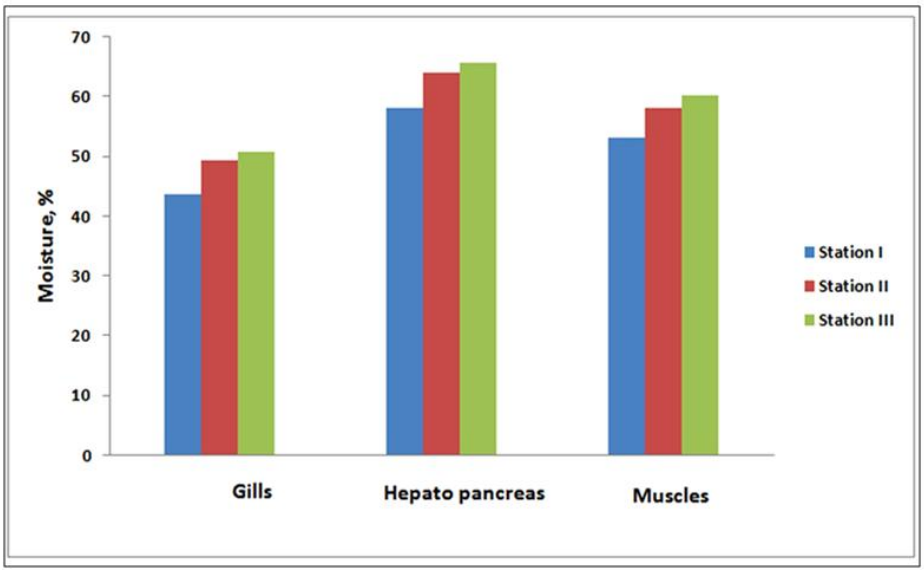

Fig.4. Moisture Content in the gill, hepatopancreas and muscle tissues of *M.rosenbergii* collected from the stations I, II and III Mettur reservoir during April, May and June, 2013

Crustacean muscles contain high concentration of free aminoacids (Cobb *et al*., 1975). The present study showed a decline in protein content in station I because the thermal stress impaired the metabolic machinery of protein synthesis. The stress in turn induced the process of proteolysis that led to rapid decline in protein concentration to meet out the high energy demand under stressful environment.The status of carbohydrate in the present study also exhibited the same trend as that of proteins (Fig. 2). Carbohydrates are considered to be the first among the organic nutrients to be utilized to generate required energy (Heath, 1987). They serve as precursors for the dispensable aminoacids and certain other nutrients which are metabolic intermediates necessary for growth. This indicates the availability of such an important and immediate energy precursor in the wild for the survival and growth of *M.rosenbergii*. The rapid depletion of carbohydrates at station I and during April, May and June, 2013, was due to the excess utilization of the glycogen reserve to withstand the thermal and heavy metal stress due to the themal power station discharges.

The level of lipids also falls in line with the protein content in all stations studied (Fig. 3).Lipids are extremely important in maintaining structural and physiological integrity of cellular and sub-cellular membranes. Lipids are the best source of energy producers of the body through metabolism (Richardo *et al*., 2003). The hepatopancreas is the main lipid storage organ (Chanmugam *et al*., 2006) while the muscle of prawn contains lower quantity of lipids (Bhavan, 2009). The moisture content also showed an increasing trend in the months January, February and March 2013 at station I when compared with that of the other months and stations respectively. Prawns are normally highly perishable because of their high moisture content. The higher amount of ash shows the richness of the food in terms of elemental composition. The dynamics of these biochemical components involved in energy metabolism are regulated by various factors such as sex, reproductive cycle, capture period, food availability, hydrologic cycle, pollutant status and seasonal influence (May-ku *et al*., 2006; Nargis 2006).

Conclusion

The prawns *M.rosenbergii* collected from all the three stations showed reasonably good proximate composition, despite the thermal discharge in station I that revealed a significant variation in their biochemical components. This showed that wildness exhibiting in the natural environment has provided the required nutrients to the prawns. Because, such natural environments shouldhave been encompassed by all nutrients which in turn would have been consumed by the prawns due to their omnivorous feeding habit. However, the prawns sampled from station I revealed poor proximate composition when compared with that of the stations II and III, which may be because of the physical, chemical and biological conditions related to the habitat. Furthermore the thermal stress coupled with the heavy metal toxicant stress would have still deteriorated the biochemical constituents of the prawns from station I. Hence, it is being suggested to focus special attention towards the living organisms including crustaceans inhabiting the polluted zones.

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