Proc. Indian natn. Sci. Acad. **B46** No. 4 pp 501–504 (1981)

Changes in the Serum Proteins of a Freshwater Crab, *Paratelphusa hydrodromus* (Herbst) Acclimated to Different Salinities

T S RAJESWARI and E RADHA
Department of Zoology, Bangalore University, Bangalore 560001

(Received 22 August 1980)

Acclimation of freshwater crab, *Paratelphusa hydrodromus* (Herbst) from its natural medium to one with a higher ionic concentration resulted in a significant decrease in the amount of serum total proteins and globulins in contrast to an increase in albumin and copper-containing proteins. The degree of change in the above parameters is related to the concentration of the medium while body size of the animal has very little effect except on copper-containing proteins. The causes and physiological implications of these biochemical changes are discussed with reference to salinity adaptation.

Key Words: Salinity acclimation, Salinity adaptation, Serum total proteins, Albumin, Globulins, Haemocyanin

Introduction

Changes in salt and water balance, the level of inorganic ions and their impact on intermediary metabolism of crustaceans exposed to different salinities have already been reviewed (Potts & Parry, 1964; Huggins & Munday 1968, Prosser 1973). Vincent-Manique and Gilles (1970) and Gilles (1977) have studied amino acid and protein metabolism in the euryhaline crustacean *Eriocheir sinensis* as a function of salinity acclimation. The present paper reports the changes in different protein fractions in the serum of freshwater crab *Paratelphusa hydrodromus* in relation of salinity adaptation.

Materials and Methods

Two sets of male crabs, one set weighing 10 ± 3 g (group A) and another weighing 40 ± 5 g (Group B) were used for the study. In the laboratory they were maintained at $28\pm1°$ in glass troughs containing fresh water for 3 days before use. The water was renewed daily and the animals were fed *ad libitum* with minced thigh muscle of frog before and during experiments. The crabs were brought to higher salinities through intermediate salinities and 1%, 2% and 3% sodium chloride (lab. grade) solutions were used to provide experimental media of different salinities. These concentrations

along with that of control condition represented a range of salinities from fresh water to sea water (Kinne 1964, Prosser 1973). The animals were adapted to the experimental media for 4 weeks.

The serum was drawn by means of a hypodermic syringe through a small incision in the arthrodial membrane at the base of the appendages.

Total proteins, albumin and globulins were estimated as described by Oser (1965). Copper was estimated according to Gubler et al. (1952).

The data were statistically analysed using student's *t*-test and significant differences between means were calculated as *p*-values (table 1).

Results (table 1)

There was a highly significant (15.9%) decrease in total proteins in gr. A ($p<0.001$) and 16.8% in gr. B ($p<0.001$) in the serum of animals acclimated to 3% sodium chloride medium. Globulin in gr. A decreased by 56.4% ($p<0.001$) and in gr. B by 57.9% ($p<0.001$). Albumin and haemocyanin in terms of copper (Prosser 1973) increased in gr. A by 16.7% ($p<0.001$) and 33.3% ($p<0.001$) and in gr.B by 14.9% ($p<0.001$) and 38.6% ($p<0.001$) respectively. Further, though the animals acclimated to 1% and 2% sodium chloride media showed smaller changes in all the parameters studied, the differences were significant.

Table 1 *Total proteins, albumin, globulin, A/G ratio and copper content in the serum of* Paratelphusa hydrodromus *acclimated to different salinities*

Group	Medium of acclimation	Total proteins mg/ml	Albumin mg/ml	Globulin mg/ml	A/G	Copper mg/ml
A	Fresh water	8.80±0.21	4.80±0.15	3.90±0.36	1.23	66±1.6
	1% NaCl	8.20±0.23* (6.8%)	5.10±0 12@ (6.3%)	3.00±0.31* (23.1%)	1.70	72±2.3* (9.1%)
	2% NaCl	7.70±0.19† (12.5%)	5.50±0.18† (14.6%)	2.10±0.22† (46.2%)	2.52	81±2.4† (22.7%)
	3% NaCl	7.40±0.11† (15.9%)	5.60±0.16† (16.7%)	1.70±0.14† (56.4%)	3.29	88±3.5† (33.3%)
B	Fresh water	8.65±0.25	4.70±0.19	3.80±0.44	1.23	70±2.1
	1% NaCl	8.00±0.15* (7.5%)	5.00±0.11* (6.4%)	2.90±0.43* (23.7%)	1.72	79±2.8* (12.9%)
	2% NaCl	7.70±0.22* (11.0%)	5.35±0.07† (13.8%)	2.30±0.33† (39.5%)	2.32	86±3.1† (22.9%)
	3% NaCl	7.20±0.21† (16.8%)	5.40±0.08† (14.9%)	1.60±0.29† (57.9%)	3.37	97±3.4† (38.6%)

Values are represented as mean ± SD of four observations
Values in parenthesis indicate % change from the controls
@ $p<0.02$; * $p<0.01$; † $p<0.001$

Discussion

It is clear from table 1 that acclimation of the crab *Paratelphusa hydrodromus* to media of higher ionic concentration depleted serum total protein and globulin content while albumin and copper-levels were elevated. Further, the degree of change in the above parameters is related to the concentration of the medium while body size seems to have very little effect except on copper-containing proteins.

Gilles (1977) reported a highly significant drop in the total serum protein content in *Eriocheir sinensis* upon acclimation from fresh water to sea water. This has been attributed to an increased degradation and/or decreased synthesis of serum peptidic material. Further, Huggins and Munday (1968) have stated that protein catabolism and an increased metabolism of amino acid carbon skeleton occurs during prolonged periods of stress. These observations are in support of the decrease in serum total proteins observed in the present study.

An increase in the principal respiratory protein haemocyanin (estimated in terms of copper) observed is interesting since it can be related to the change in oxygen consumption which has been reported in crustaceans acclimated to media of different salinities (Rao 1958, Ramamurthi 1967). Such an increase in haemocyanin content would mean an increased oxygen-carrying capacity of blood. This increase in haemocyanin content associated with increased oxygen consumption (Rao 1958, Ramamurthi 1967) would mean an increase in the rate of oxidative metabolism. This has a support in Ramamurthi's (1966) study on the activity of succinic dehydrogenase under conditions of altered salinities which has been shown to increase in the gill and hepatopancreas of *Paratelphusa hydrodromus* (Herbst). These facts can be correlated with the increase in albumin observed since hepatopancreas might be actively involved in the synthesis of the acidic protein as shown under conditions of cold stress (Govindappa & Rajabai 1976) although the physiological significance of such an increase differs with the type of stress. The suggestion made by Siebers et al. (1972) and Gilles (1977) that the free amino acids formed by increased degradation could be actively transported from blood into tissues would also account for the increased synthesis of albumin by hepatopancreas and a corresponding increase in the serum which mainly functions in the maintenance of osmotic balance.

Of the two groups, it is seen that changes in haemocyanin content are more marked in group B than in A. This is in support of Rao's (1958) results on the prawn *metapaenaeus monoceros* Fab. in which oxygen consumption as a function of salinity has been shown to increase with increase in body size.

Precise significance of decrease in globulin content and increase in albumin/globulin ratio observed is difficult to explain. These, together with other factors might function in establishing a new equilibrium. However, it is clear from the results that serum proteins have a significant role in adaptation to increasing salinities.

Acknowledgements

One of us (T S R) acknowledges the award of a junior research fellowship by the Council of Scientific & Industrial Research, New Delhi.

References

Gilles R 1977 Effect of osmotic stresses on the protein concentration and pattern of *Eriocheir sinensis* blood; *Comp. Biochem. Physiol.* **56** 109–114

Govindappa S and Rajabai B S 1976 Some aspects of protein metabolism in crab *Paratelphusa hydrodromus* (Herbst) during cold acclimation; *J. Anim. Morphol. Physiol.* **23** 76–84

Gubler C J, Lahey M E, Helen Ashenbrucker, Cartwright G E and Wintrobe M M 1952 A method for the determination of copper in whole blood, red blood cells and plasma; *J. Biol. Chem.* **196** 209–220

Huggins A K and Munday K A 1968 Crustacean metabolism; *Adv. Comp. Physiol. Biochem.* **3** 271–378

Kinne O 1964 Non-genetic adaptation to temperature and salinity; *Helgol. Wiss. Meeresunters* **9** 433–458

Oser B L 1965 *Hawk's Physiological Chemistry* 14th ed. (Bombay: Tata McGraw-Hill Publishing Co. Ltd.) 1083–1085

Potts W T W and Parry G 1964 *Osmotic and Ionic Regulation in Animals* (Pergamon Press) 423 pp

Prosser C L 1973 *Comparative Animal Physiology* (W B Saunders Company) 71 pp

Ramamurthi R 1966 Succinic dehydrogenase activity in a fresh water crab in relation to salinity stress; *Comp. Biochem. Physiol.* **19** 645–648

—— 1967 Oxygen consumption of a freshwater crab *Paratelphusa hydrodromus* in relation to salinity stress; *Comp. Biochem. Physiol.* **23** 599–605

Rao K P 1958 Oxygen consumption as a function of size and salinity in *Metapaenaeus monoceros* Fab. from marine and brackish water environments; *J. exp. Biol.* **35** 307–313

Siebers D, Lucu C, Sperling K R and Eberlein K 1972 Kinetics of osmoregulation in the crab *Carcinus maenas*; *Mar. Biol.* **17** 291–303

Vincent-Manique C and Gilles R 1970 Modification of the amino acid pool in blood and muscle of *Eriocheir sinensis* during osmotic stress; *Comp. Biochem. Physio.* **35** 479–485