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STUDIES ON OSMOTIC BALANCE AND ITS CONTROL IN THE FRESHWATER MOLLUSC PARREYSIA CORRUGATA

V. S. LOMTE & S. N. BARHANPURKAR

Department of Zoology, Marathwada University, Aurangabad 431 004, India

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Abstract

Percent increase in body weight of 48 hours cerebralactomized mussels in tap water was significantly higher than in control mussels. 48 hours cerebralactomized mussels, injected with cerebral ganglia homogenate, restored their body weight to the normal level in tap water. 48 hours cerebralactomized mussels injected with saline solution did not show any significant increase in weight.

The aminoacid levels were studied by introducing the mussels in different salinities. There was an increase in the amino acid content as the percent salinity increased. Thus it may be inferred that osmotic balance in *Parreysia corrugata* is controlled both by cerebral neurosecretion and by amino acid levels.

Introduction

Osmotic balance may be defined as the maintenance of total particle concentration of the body fluid at levels different from those of the external media. All freshwater molluscs show hyperosmotic regulation maintaining a higher concentration of ions in the blood than that of the medium. This means that freshwater molluscs maintain a hyperosmotic internal medium living in a hypo-osmotic medium of freshwater. Such animals have, therefore, been guarded against the efflux of salts by diffusion, excretion of urine and influx of water. A freshwater animal, therefore, requires active mechanisms for establishing low permeability of water, water elimination and salt retention. The freshwater bivalves, due to their method of feeding, are more drastically affected by changes in salinity of the medium (Hunter, 1964).

In recent years, studies on osmotic balance in aquatic animals were chiefly concerned with (1) finding the relationship between the concentration of the body fluid to the normal environment, (2) locating the organs responsible for regulating the concentration of body fluids and (3) correlating the effectiveness of the mechanism with the needs of the animal in its natural habitat. These problems have been investigated in the freshwater molluscs chiefly by Florkin, (1938) on *Anodonta cygnaea,* Krogh (1938), on freshwater molluscs, Hiscock (1953), on *Hyridella australis,* Potts (1954), on *Mytilus* and *Anodonta,* Ramamurthi (1965), on freshwater piokilotherms and by Nagabhushanam & Lomte (1971) on the freshwater bivalve *P. corrugata.* The literature has been reviewed by Robertson (1964), Potts & Parry (1964) and Potts (1968).

From the literature it also appears that only a few freshwater bivalves, such as *Unio tumidus* (Fahrmann, 1961) *Dreissena polymorpha* (Anthennisse, 1963), *Anodonta cygnaea* (Salanki & Baranyi, 1965) and *Parreysia corrugata* (Nagabhushanam & Lomte, 1974), have been studied. The studies mostly include neuroendocrine regulation of various physiological processes.

In the present work osmoregulation in *Parreysia corrugata* has been investigated in relation to neuroendocrine regulation as well as correlation between osmotic balance and amino acid levels.

Material and methods

The freshwater bivalves, *P. corrugata,* were collected from the Godavari river at Paithan (Dist. Aurangabad). They were acclimated to laboratory conditions for 24 hours. Ten mussels of equal age and size were taken, weighed and decerebrated. Then these mussels were weighed at 24, 36, and 48 hours. The injections of cerebral ganglia (2 ganglia/1 ml. water dose) were given in the foot of the mussel. They were weighed at 12 hours interval i.e. at 60 hours and 72 hours from the start of the experiment.

To find out correlation between amino acids and osmotic balance, amino acids from *P. corrugata* were identified by the paper chromatographic method (Block *et al.,* 1958) and the effect of sodium chloride on amino acid concentration was studied. Amino acids were detected from the

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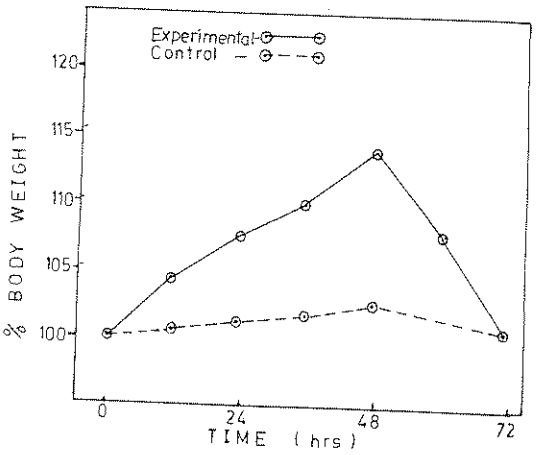

Fig. 1. Osmotic balance in relation to cerebral neurosecretion in *Parreysia corrugata.*

midgut gland by keeping mussels in freshwater as well as in 0.1, 0.3 and 0.5% sodium chloride solution for 24 hours.

Results and discussion

The weight of the experimental mussels increased upto 48 hours and later on the mussels restored their original weight in 24 hours, after receiving the cerebral ganglia injection, i.e. at 72 hours, from the beginning of the experiment. The control mussels in tap water do not show any significant change in body weight (Fig. 1).

In *Parreysia corrugata* amino acids were estimated from the midgut gland. The paper chromatographic method has shown the presence of cysteine, ornithine, aspergine and homoserine in concentrated forms, while citrulline was present in traces. When the mussels were kept in different sodium chloride concentrations (0.3%, 0.5 NaCl), the amount of cysteine, ornithine, aspergine, citrulline and homoserine increased but amino acids did not show much difference in 0.1% NaCl (Table 1).

Table 1. Effect of salt concentration on the amino acid content in *P. corrugata*

Amino acid	Rf value	0%	0.1%	0.3%	0.5%
			(Percentage of NaCl)		
Cysteine	0.0695	+	+	++	++
Ornithine	0.1528	+	+	++	++
Aspergine	0.1828	+	+	++	++
Citrulline	0.2570	+	++	++	++
Homoserine	0.2972	–	+	++	++

– nil, + low conc. ++ high conc.

The increase in weight of cerebralactomized mussels may be caused by the flow of water from the outside medium. After 48 hours a decrease in weight was observed which might be due to control over the flow of water from the outside media. This indicates that the cerebral ganglia of the mussels control the penetration of water. The ganglia appear to elaborate some hormonal factors acting on the ionic equilibrium. Lubet & Pujol (1963) and Lubet (1960) obtained identical findings in the mussels they studied. Studies of Florkin and coworkers (1965, 1972) clearly showed that amino acids play an important role in the osmoregulation of animals. Amino acids are osmotically very active. They are important for the maintenance of internal osmolarity. Intracellular osmotic adjustment appears to result from the fluctuations of free amino acids rather than from inorganic ions.

In *P. corrugata* amino acid concentration increased when they were kept in 0.3% and 0.5% salt concentration. Needham (1957) found that when *Eriocheir sinensis* was transferred from freshwater to sea water, the intracellular composition of aminoacids increased. Allen (1961), on *Rangia,* found a linear increase in amino acids with increasing salinity upto 17%, but a decrease in still higher salinities. In *P. corrugata* the amino acid concentration increased according to the increase in osmolarity of the surrounding fluid.

So we may conclude that both cerebral ganglia and amino acids play an important role in maintaining osmotic balance in the freshwater mussel, *P. corrugata.*

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