OSMOREGULATION BY MEANS OF A HITHERTO UNSUSPECTED OSMOREGULATORY ORGAN IN TWO GRAPSID CRABS

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Parry (1954, 1960), Prosser (1955), and Potts and Parry (1964) all stress that extra-renal routes of water elimination remain to be discovered in the Crustacea. Parry (1960) suggests a number of likely organs, but does not include the diverticula of the alimentary canal present in some Brachyura. Of these diverticula, the posterior opens into the hindgut, and, by virtue of its position, seems unlikely to serve any digestive function. The possibility that this organ is concerned with water excretion was investigated by us.

In hypotonic external media, ligaturing of the diverticulum *in vivo* upsets the osmoregulatory ability of the grapsid crabs *Cyclograpsus punctatus* Milne-Edwards and *Plagusia chabrus* L.; it also gives rise to a marked swelling of that part of the diverticulum distal to the ligature. *In vitro* studies on the diverticulum of *C. punctatus* confirm this and show that an active process is involved. Poisoning with cyanide immediately inhibits the further passage of water from a hypotonic medium into the lumen of a ligatured, excised diverticulum, and the organ slowly resumes its normal size. The anterior diverticula behave in the same way and may be concerned with the maintenance of a constant haemolymph osmotic pressure in the antero-lateral regions of the haemocoel, but this requires more critical study.

There is considerable difference between the abilities of *C. punctatus* and *P. chabrus* to tolerate hypotonic external media. *C. punctatus* can survive salinities as low as that of 10% seawater for 144 hours or more, and can be kept in distilled water for up to 24 hours. It is normally found at high water levels (HWS—HWN) where shelter in the form of loose rocks is present in the intertidal zone and also in estuaries, where it is subject to considerable fluctuations in salinity. Salinities below that of 70% seawater usually prove fatal to *P. chabrus*, although some individuals will survive as long as 36 hours in 60% seawater. This species inhabits the infralittoral regions off rocky shores and also rock pools in the lower intertidal zone, where some slight fluctuations in salinity occur due to evaporation and rain. It does not occur in estuaries.

Samples of from four to six starved crabs of each species were subjected to different dilutions of seawater, and their respective water gains at each dilution were determined. The duration of any one experiment depended upon survival of the species at a particular dilution; for *C. punctatus*, in the range 10% to 100% seawater, the experiments were continued for 144 hours, but in distilled water they were limited to 24 hours. *P. chabrus* was kept in 70% to 100% seawater for 96 hours and in 60% seawater for 36 hours. Fig. 1 shows, for both species, the relationship between water gain, expressed as a percentage of original wet body weight, and the concentration of the external medium. The more efficient osmoregulatory ability of *C. punctatus* reflected here is confirmed by the constancy of its haemolymph osmotic pressure in the face of changes in the osmotic pressure of the external medium. Fig. 2 shows the

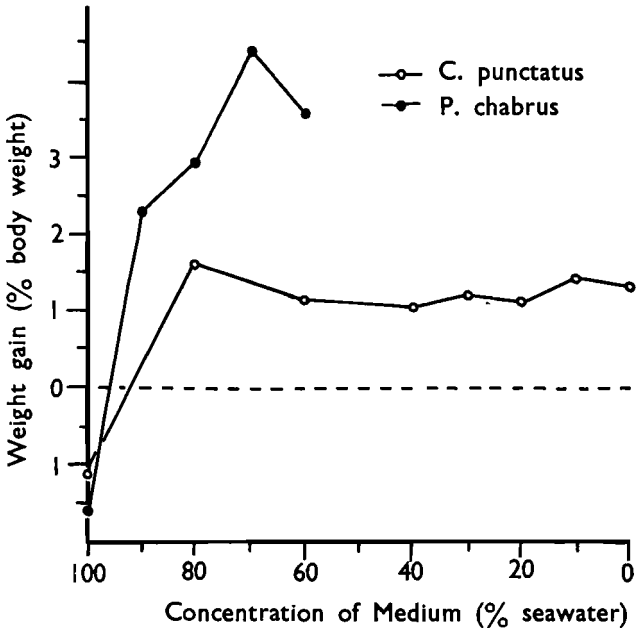

Fig. 1 Water gain by *C. punctatus* and *P. chabrus* in different dilutions of seawater.

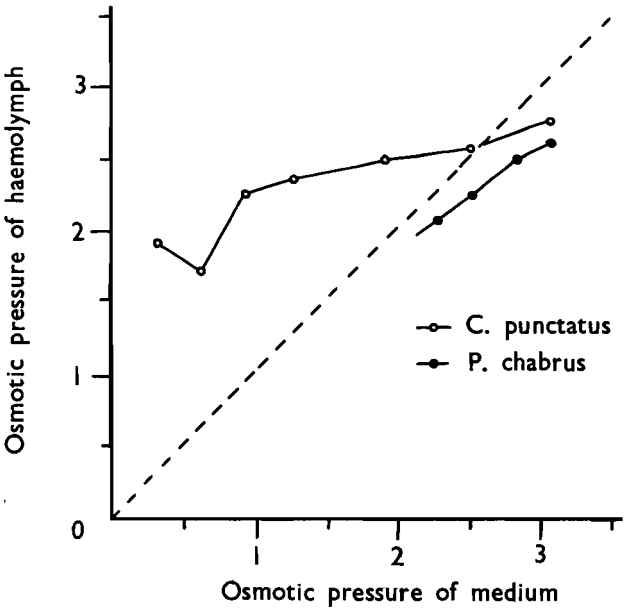

Fig. 2 Relationship between haemolymph and external osmotic pressures. Osmotic pressures expressed as equivalent percentage NaCl.

relationship between haemolymph and external osmotic pressure for the two species. That they both maintain their haemolymph osmotic pressure below that of seawater is in agreement with findings for other grapsoid crabs. Regulation against hypertonicity of the medium, probably by means of salt excretion and/or water absorption against a concentration gradient, is necessary for survival in the habitats mentioned, where the crabs are subject to drying or to higher salt concentrations caused by evaporation. In regulating against hypotonicity of the medium, however, *C. punctatus* shows a considerable advance over *P. chabrus*. This implies more efficient water excretion and salt absorption and/or greater general impermeability in the former.

The relative lengths of the posterior diverticula are markedly different in the two species studied. In *C. punctatus* the length, expressed as a function of the weight of the crab, is 3.383 mm. of diverticulum per gram of wet body weight, while that of *P. chabrus* is only 1.086 mm./g. The posterior diverticulum of *C. punctatus* is therefore relatively three times as long as that of *P. chabrus* and we tentatively suggest that the greater osmoregulatory powers of the former can be attributed, at least in part, to the greater secretory area associated with its longer diverticulum.

The histology of both the anterior and posterior diverticula, and their role in ionic regulation, are at present being investigated.

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