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Excretion in the Lobster, Homarus: IV

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Although normal lobsters have a substantial daily urine flow, many purchased from pounds are and remain completely anuric. In these latter, transitory urine flows can be induced by the injection of solutions of electrolytes of various tonicities. Permanent urine formation was induced-in anuric animals by the transfusion of serum (10-15 ml. from urine producing lobsters. Anuric lobsters have a low plasma protein.

Lobsters of all conditions had 11-62 gms./l. of non-electrolyte solids with about 50 gms./l., and 950 gms. H_2O/l. of plasma being the average for so-called normal lobsters. Previous freezing point depression measurements showed the plasma often slightly hypertonic to sea water. Within the limits of the exoskeleton, a lobster is not filled with fluid. An extra 15-25 ml. of fluid can always be injected into a 500 gm. animal without excessive back-pressure. The above data indicate that non-diffusable blood solutes draw in water, which is removed by the nephridia when excessive.

While electrolyte values were measured for sea water, plasma, and urine, nothing new except for the higher value for plasma solids was learned over the previous analyses of Smith, Cole and Robertson. Cole's finding that in dilute sea water, the lobster can concentrate blood Cl was confirmed and extended by the observation that the nephridia do not aid in the conservation of Cl. Under dilute conditions urinary Cl rises proportionally to the elevation of blood Cl. Chloride concentration seems to be an active one performed by the gills. Dialysis of plasma against sea water and dilute sea water gave equilibria characteristic of intact lobsters (before Cl concentration begins for the animals under dilute conditions). There is therefore no unusual passive partitioning effect characteristic of the gills. It appears that in undiluted sea water the distribution of Cl between sea water, plasma, and urine is primarily passive. Calculation of plasma Cl as mM/l. H_2O gives ratios essentially of 1 for sea water plasma, and plasma-urine. Following injections of hypo- or hypertonic NaCl sufficient to disturb plasma levels, or the moving back and forth between dilute and undilute sea water, plasma Cl shifts along a smooth curve which after several hours asymtotically approaches but does not meet the value for the external medium. That is, there appears to be no marked active resistance to a change in plasma Cl in the hours proximate to its disturbance. That this free shift is not merely osmotic dilution is indicated by the fact that the main movement of water, as judged by weight changes, is accomplished in less than one hour. The analytic assistance of Fredrik Berglund (Brunn method) and Henry Heinemann (conductivity method) is acknowledged gratefully.

Aside from finding that with dilution or concentration of the external medium, Na shifts freely, this ion was not studied experimentally.

On a corrected basis, the plasma Na/Cl ratio is essentially 1. The plasma contains over 10 % more Na than sea water, and over 5% more than the urine. The sea water-plasma difference can be accounted for on the basis that the extra plasma Na takes the place of the excluded sea water Mg which is not equalized by sea water sulphate. We have no idea how to account for the apparent retention of Na from the urine, beyond speculation. Superficially, there seems to be no good reason why so abundant and mobile an ion should be conserved. It seems more likely that either some of the plasma sodium is bound to plasma anions which do not enter the urine or that the total urinary cation total requires the exclusion of some Na. There is also a marked tendency for urinary K values to be below the plasma values.

For lobsters in their normal undiluted environment the movement of water and the net electrolyte flux seems to an inward one. The substantial urine flows alone point to this. Injected iodide disappears from the plasma very slowly, although its disappearance can be hastened by placing the lobster in dilute sea water. External iodide appears in the plasma more quickly. In general, the lobster seems to be perfused through gills and stomach by an isotonic NaCl solution which is lost from the nephridia. Divalent ions enter from the stomach. The nephridia and the gills (for urea at least) are exit valves both selective and non-selective. Compared to vertebrates, the concentrating powers of the nephridia for many substances are low.

Further Study of the Renal Excretion of Trimethylamine Oxide in the Dogfish

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The study of the renal excretion of trimethylamine oxide (TMAO) begun the previous year was continued. Plasma levels of TMAO in five dogfish shortly after capture ranged between 60-90mMol/ml. In two fish kept in the live car for 27 and 17 days respectively, there was no appreciable change in plasma TMAO concentration. Although further substantiation is necessary, this may indicate that the TMAO in the dogfish is of endogenous origin since these fish are not thought to eat while in captivity. As previously reported by Rieck et al (1954), TMAO is reabsorbed by the dogfish renal tubules. The U/P ratios obtained by us were always below 1.0. It should be noted that the highest TMAO urine concentrations and rates of excretion occurred in fish following administration of epinephrine.

Some preliminary data have been obtained indicating that a free amine is produced by the dogfish kidney. Although no free amine has been