
In fish living in fresh water the kidneys are in general the main pathway to excrete the surplus water that enters osmotically via the gills. However, during the reproductive period in male sticklebacks, under the influence of testosterone, most of the renal tubule cells lose their normal function and are transformed into mucus-secreting cells. This implies a considerable loss of ion reabsorptive capacity. In the glomeruli also, testosterone-dependent changes take place which probably lead to a reduced glomerular filtration rate and decreased urine production. Thus, in sexually mature sticklebacks an important pathway for the elimination of water is lost. However, our data show that in these male fish the intestine may play an important role in hydromineral regulation. Sexually mature males excrete a slightly hypotonic fluid in amounts that are about three to four times higher than in immature males, which produce only small amounts of isotonic intestinal fluid. Measurements of branchial and intestinal osmotic permeability to water, according to an in vitro method, showed that the osmotic permeability of the gills, from water to blood, remains unchanged. However, the osmotic permeability to water from blood to lumen of both the anterior and posterior intestine is significantly enhanced in mature males. Our experiments have also shown that this phenomenon is controlled by testosterone. Our electron microscopical investigations have shown that a well-developed basolateral system of infolded membranes, the basal labyrinth, is present in the epithelial cells of the anterior as well as the posterior intestine. This is in contrast to other fish species in which a basal labyrinth is present in either the anterior or the posterior intestinal epithelium. We conclude that the observed fluid secretion into the intestinal lumen may take place according to the “backward channel” concept for solute-linked water transport.

42. Effects of Captopril on Water Metabolism of Rana temporaria. J. P. Bolton and I. W. Henderson. Department of Zoology, University, Sheffield S10 2TN, U.K.

The renin–angiotensin system (RAS) is a prime regulator of water metabolism of most, if not all, vertebrates as a result of its actions on neurohypophysial hormone release and on aldosterone secretion, and because of its primary dipsogenic actions. Amphibians appear exceptional, especially with regard to the latter actions of angiotensin II. These studies assess the actions of the RAS on voluntary fluid intake in an anuran amphibian, Rana temporaria. Animals were adapted to solutions hyperosmotic to their blood plasma with and without treatment with diuretics and after treatment with an inhibitor of the RAS (Captopril) in the presence and absence of the kidneys. Drinking was measured by monitoring phenol red uptake from the environment. In tap water, frogs drank to a very limited extent (81.2 ± 22.2 µl/hr/100 g body wt; n = 6), some 5% of the total water intake; for the first 5 to 10 min after being placed in hyperosmotic saline the frogs drank copiously, and then this voluntary intake fell significantly (24.0 ± 2.6 µl; n = 6). Captopril had no effect on the drinking of tap-water-adapted frogs, significantly increased that of saline-adapted frogs (245.5 ± 60.5; n = 6), and had no effect on the drinking of nephrectomized animals. Diuretics (frusemide and acetazolamide) and nephrectomy produced enigmatic actions on drinking to suggest that the drinking behaviour of anurans is controlled in different ways from that of other tetrapod vertebrates.


The skin of aquatic-phase newts (Taricha torosa) exhibits significantly lower electrical conductance than does skin from terrestrial-phase animals, as measured in vitro. Increased resistance in both active and shunt pathways, as well as decreased transepithelial potential (TEP), are the major causative factors. Administration of ovine prolactin (2 µg/g daily for 1 week) to intact, terrestrial-phase newts caused the skin to become electrophysiologically indistinguishable from that of aquatic-phase animals. Comparison of in vivo with in vitro measurement of TEP in the same animals showed the in vivo methods to yield consistently higher values at [Na+] ext of 0.1–100 mEq/liter. Prolactin treatment (0.8–8.0 µg/g) of intact, adult terrestrial-phase newts (T. granulosa) or juvenile efts (Notophthalmus viridescens) significantly reduced in vivo TEP in 2–4 days. Animals receiving comparable doses of bovine growth hormone increased in body size, but did not show significant changes in in vivo TEP, even after 24 days of treatment. Prolactin decreased in vivo TEP in a dose-dependent manner in both newts (0.1–1.00 µg/animal, b = 11.9 mV/10× hormone) and efts (0.05–10 µg/animal, b = 28.8 mV/10× hormone). The minimum total effective dose of prolactin (ovine) in T. granulosa was 0.025 IU and in efts was 0.010 IU. The sensitivity and specificity of the action of prolactin on in vivo TEP in newts suggests