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Plasma membrane preparations of gills contain two Ca\(^{2+}\)-dependent phosphatase activities. Ca\(^{2+}\)-activated ATP hydrolytic activity, often reported as Ca\(^{2+}\)-ATPase in literature on fish gills, was identified as a heterogeneous, nonspecific phosphatase that i.a. hydrolyzes Ca\(^{2+}\)-ATP. We further identified a homogeneous, high-affinity, calmodulin-dependent (Ca\(^{2+}\) + Mg\(^{2+}\))-ATPase (K\(_m\): 0.22 \(\mu\)M Ca\(^{2+}\), V\(_{max}\): 5.41 \(\mu\)mol P, hr\(^{-1}\) mg protein\(^{-1}\)). We consider the latter ATPase activity to be directly involved in active trans-epithelial transport of Ca\(^{2+}\). In eels exposed for 3 weeks to low-calcium fresh water (0.1 mM Ca\(^{2+}\)), a reduction of environmental calcium is known to increase branchial permeability for mono- and divalent ions. The resulting passive loss of ions will likely be compensated for by increased branchial active uptake of ions like Na\(^{+}\) and Ca\(^{2+}\). This may explain the enhanced Na\(^{+}/K^{+}\)-ATPase and high-affinity (Ca\(^{2+}\) + Mg\(^{2+}\))-ATPase activity. The nonspecific phosphatase activities may be related to ion transport phenomena (permeability control?). Prolactin treatment of freshwater eels increased the high-affinity (Ca\(^{2+}\) + Mg\(^{2+}\))-ATPase activity without affecting Na\(^{+}/K^{+}\)-ATPase or nonspecific phosphatase activities. This increase in high-affinity (Ca\(^{2+}\) + Mg\(^{2+}\))-ATPase activity may part of the mechanism via which prolactin exerts its hypercalcemic action in freshwater fish.


During ovarian growth many female fish show extremely high plasma calcium and phosphate levels. This is due to the presence of calcium- and phosphate-binding proteins (vitellogenins), which are synthesized in the liver and, after transport via the blood, are taken up by growing oocytes. Estradiol injections can elevate plasma vitellogenin levels and also induce demineralization of scales and bones. It has therefore been concluded that the calcium and phosphate incorporated in the ovaries are mobilized from bone and, especially, scales. This hypothesis has been studied in tilapia. During ovarian growth tilapia has high levels of calcium- and phosphate-binding proteins in the blood, and the calcium and phosphate levels in the ovaries increase steadily until ovulation. However, no evidence for the mobilization of bone minerals could be obtained. This indicates that under normal conditions bone does not act as a calcium and phosphate supply for the ovaries. It has been shown that in tilapia calcium uptake is mainly via the gills, whereas phosphate uptake takes place almost exclusively in the gut. When tilapia are fed a calcium- and phosphate-deficient diet during ovarian maturation, severe demineralization of scales and skeletal bones was observed. Remarkably, only the phosphate content of the bones and scale matrix was decreased, and not the calcium concentration. Ovarian growth continued, although slowly. These data show that calcium and phosphate deposited in the ovaries under control of estrogens originate from the water (calcium) and from the food (phosphate). If phosphate from food is not available, it can be specifically mobilized from bone. Bone demineralization observed after estradiol-injections in normally fed fish may be due to nonphysiological dosage of the hormone.

191. Vitamin D\(_3\) Metabolites and Their Possible Roles in Calcium Homeostasis in Salmo gairdneri. M. HAYES, D. GUILLAND-CUMMING, L. W. HENDERSON, AND R. G. G. RUSSELL, Departments of Zoology and Human Metabolism and Clinical Biochemistry, University, Sheffield S10 2TN, U.K.

The vitamin D\(_3\) endocrine system is poorly described in teleost fishes. These studies aimed to identify likely components of the system in the rainbow trout, Salmo gairdneri, and to assess the possible roles of the metabolites in fish adapted to varying environmental calcium concentrations including sea water. Indwelling intravascular catheters were placed in trout and titrated 25-OH-cholecalciferol was administered; disappearance rates and further transformations to metabolites such as 1,25 dihydroxycholecalciferol, 24,25 dihydroxycholecalciferol, and 25,26 dihydroxycholecalciferol were assessed. These experiments gave qualitative information on in vivo production of the active hormonal components of the vitamin D\(_3\) endocrine system. A relationship between environmental and plasma calcium concentrations and the pattern of metabolite formed suggested that, with decreasing calcium availability, 1,25 (OH\(_{2}\))D\(_3\) predominated, while 25,26 (OH\(_{2}\)) production occurs in calcium enriched environments. Liver, kidney, gut mucosa, gill filaments, scales, and corpuscles of Stannius were specifically assayed for hydroxylating activity, and only the liver displayed significant activities of 1 and 26 hydroxylases. The trout thus present information that suggests that, as a representative teleost, these fish...