Mechanism of Ammonia Excretion by the Fish Gill

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Marine shorthorn sculpins, Myoxocephalus scorpius, were used to determine whether branchially excreted NH_3, which constitutes about four-fifths of the total nitrogenous wastes of fishes, is derived exclusively from diffused blood NH_3 or whether some is formed peripherally at the gill from plasma precursors. Measurements of cardiac output and NH_3 differences in blood entering and leaving gills of 500 gram fish disclosed that only 0.02 mmoles (14%) of the total 0.14 mmoles NH_3 excreted branchially per hr. could be accounted for as coming from preformed blood NH_3. Analysis of gill tissue homogenates showed that the total activity of glutaminase I and glutamic dehydrogenase in individual fish averaged 0.17 mmole NH_3/gills/hr. Thus, these two enzymatic mechanisms could account for all the NH_3 formed peripherally in the gill. Further support for this hypothesis was obtained from measurements of drops in non-protein acid-labile NH_3 as blood crossed the gill circulation. It is suggested that the "ammonotelic" nature of aquatic organisms generally could be explained by the activities of such peripherally located enzymatic mechanisms as are implicated in this study. (Supported by a grant from the National Heart Institute, H-4457.)

The Relative Importance of Gills and Kidneys in the Excretion of Ammonia and Urea by the Spiny Dogfish, (Squalus acanthias)[1]

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In combined divided box-catheterization experiments approximately 85 percent of the total nonprotein nitrogen was excreted via the gills. Renal elimination accounted for only 0.1 mmole N/kg/hr out of a combined total excretion rate of 0.75 mmole/kg/hr. Branchial excretion totalled approximately 0.5 mmole urea-N/kg/hr and 0.15 mmole NH_3-N/kg/hr. Urea excretion across the gill epithelium can probably be accounted for by passive diffusion from blood. However, diffusion of preformed NH_3 in blood could account at most for only 1/3 to 1/2 of the branchially excreted NH_3-N. Total glutaminase I activity in gills (0.3 mmole NH_3-N/kg b.w./hr) was found to be more than sufficient to account for the ammonia excreted branchially. Urine contained only a trace of NH_3-N; urea-N comprised about 70 percent of the total urinary NPN.

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