THE LOACH *MISGURNUS ANGUILLICAUDATUS*

REDUCES AMINO ACID CATABOLISM AND

VOLATILIZES NH_3 DURING AERIAL EXPOSURE

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The loach *Misgurnus anguillicaudatus* inhabits the rice field in Southern China. It encounters drought during summer and ammonia loading during agricultural fertilization. In the laboratory, aerial exposure led to decreases in its ammonia and urea excretion. However, it maintained an alkaline pH (>9) on it skin surface and can eliminate >25% of the ammonia excreted during aerial exposure as ammonia gas. This is the first fish known to be capable of doing so.

Ammonia accumulated to very high levels in the muscle and the liver. For most fishes, such high levels of ammonia in the tissue would disturb the nervous system, intracellular pH and integrity of membranes (Campbell, 1991). So, presumably, many physiological and biochemical processes in *M. anguillicaudatus* must be refractory to ammonia toxicity. Urea synthesis

through the ornithine-urea-cycle was not involved in ammonia detoxification in this fish. Very low activity of cambamoyl phosphate synthetase, which utilized glutamine as a substrate, was present in the liver mitochondria.

During the early phase of aerial exposure, *M. anguillcaudatus* accumulated alanine in its muscle. As suggested for the mudskippers (Ip et al., submitted for publication), *M. anguillcaudatus* might undergo partial amino acid catabolism, leading to the formation and storage of alanine. The process of alanine formation is not energy dependent; instead it provides a source of energy through partial catabolism of certain amino acids to support activities on land. This is not a detoxification mechanism, but a mechanism to avoid internal fouling by ammonia.

Upon prolonged exposure to the terrestrial condition, *M. anguillicaudatus* converted to glutamine formation as a means to detoxify the accumulating ammonia. So far, glutamine has only been found to play a role in ammonia detoxification in fish in response to high environmental ammonia concentration (Mommsen and Walsh, 1991), with the exception of the marble goby *Oxyeleotris marmoratus* (Jow et al, 1999). Formation of glutamine involves the hydrolysis of ATP, and it would make sense for it to take place when the fish is relatively inactive. However, different from the case of *O. marmoratus*, the glutamine accumulated in the body of *M. anguillicaudatus* could not account for the reduction in nitrogenous excretion in the terrestrial condition. Our results indicate that, similar to the mudskippers (Lim et al., submitted for publication), this loach was capable of reducing protein and/or amino acid catabolism during prolonged aerial exposure.

In its natural habitat, *M. anguillicaudatus* often encounters drought during summer. It moves actively on land until it encounters soft mud where it can bury itself through several strong wriggling action of the body. Hence, it is possible that it uses partial amino acid catabolism to fuel its short period of activities on land, and switches to the reduction in protein/amino acid catabolism, and formation of glutamine to detoxify the internally produce ammonia when it remains relatively inactive in the mud.

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