THE SNAKEHEAD *CHANNA ASIATICA* PRODUCES AND STORES ALANINE DURING AERIAL EXPOSURE

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EXTENDED ABSTRACT ONLY-DO NOT CITE

The snakehead, *Channa asiatica* is a valued food fish distributed over parts of Guangdong, China. It resides in slow-flowing streams and in crevices near riverbanks, and is a facultative air-breather, capable of terrestrial movement in an eel-like fashion. Upon aerial exposure in the laboratory, its ammonia excretion rate reduced to one-fourth that of the submerged control. Ammonia accumulated in the muscle, liver and plasma. It did not possess a complete ornithine-urea cycle and no carbamoyl phosphate synthetase activity was detected from its liver. Therefore, it was incapable of detoxifying ammonia to urea through the ornithine-urea cycle.

Instead, it accumulated alanine, asparagine and glutamine when exposed to the terrestrial condition. Different from the marble goby, *Oxyeleotris marmoratus*, (Jow et al., 1999) and the sleeper *Bostrichthyes sinensis* (Ip and Chew, unpublished results), the role of glutamine in *C. asiatica* appeared to be minor. In contrast, alanine content increased nine-fold in the muscle of *C. asiatica* during aerial exposure.

One of the primary sources of metabolic energy in carnivorous fishes is protein (Moon and Johnston, 1981). Amino acids released through proteolysis can be

either oxidized for energy production or converted to other utilizable forms by anabolic pathways. Certain amino acids (e.g. arginine, glutamine, histidine and proline) can be converted to glutamate. Glutamate can undergo deamination catalyzed by glutamate dehydrogenase, producing NH_4^+ and α-ketoglutarate (Campbell, 1991). The latter is then fed into the Krebs cycle. On the other hand, glutamate can undergo transamination with pyruvate, catalyzed by alanine aminotransferase (ALT), producing α-ketoglutarate and alanine without the release of ammonia. If there is a continuous supply of pyruvate, transamination would facilitate the oxidation of carbon chains of some amino acids without polluting the internal environment with ammonia.

Under normal circumstances, the carbon chain of an amino acid can be completely oxidized to carbon dioxide and water through the Krebs cycle and the electron transport chain, producing ATP or its equivalent. For *C. asiatica* and the mudskipper *Periophthalmodon schlosseri* (Ip et al., submitted for publication) exposed to the terrestrial condition, the carbon chain may undergo only partial oxidation. α-Ketoglutarate can be metabolized through portions of the Krebs cycle to malate. Malate can then be turned into pyruvate in the presence of malic enzyme. The presence of malic enzyme in the tissues of *C. asiatica* indicates that such a pathway is indeed possible. This strategy would cause a reduction in the efficiency of ATP production, as amino acids are not fully oxidized. However, for a fish having difficulties in excreting ammonia, this would be a useful strategy, because the pyruvate spun out of the Krebs cycle can combine with the amino group of glutamate to form alanine. This would allow the utilization of certain amino acids as energy sources without polluting the internal environment.

Aerial exposure did not affect the activities of ALT in the tissues of *C. asiatica*. An examination of the mass action ratio of the reaction catalyzed by ALT in the muscle of specimens exposed to the submerged or terrestrial condition revealed that isozymes of ALT might exist in this fish.

During the 48 h of aerial exposure, the reduction in nitrogenous excretion could be completely accounted for by the accumulation of various nitrogenous compounds, especially ammonia and alanine. This suggests that *C. asiatica* did not resort to suppressing protein and amino acid catabolism under such a condition. In this regard, it is different from the mudskipper *P. schlosseri*, which is capable of undergoing partial catabolism of certain amino acids and suppressing protein catabolism simultaneously (Lim et al., and Ip et al., submitted for publication).

References

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