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Gill-specific glutamine synthetase

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The enzyme **glutamine synthetase** (GS) has a central role in cellular nitrogen metabolism. By carrying out the ATP-dependent formation of glutamine from ammonia and glutamate, GS detoxifies ammonia and conveys nitrogen for urea, amino acid and nucleotide biosynthesis. In the May **Journal of Experimental Biology**, Patrick Walsh and colleagues at the **University of Miami**, Florida, US, describe intriguing new features of the enzyme from Gulf toadfish (*Opsanus beta*), and reveal that despite previous intense study GS still holds many secrets (*Journal of Experimental Biology*, **206**:1523-1533, May 1, 2003).

Walsh *et al.* focused on nitrogen metabolism in the toadfish because it can facultatively excrete nitrogen as ammonia (ammonotelic) or as urea (ureotelic). They assessed GS enzymatic activity and scrutinized mRNA in several key tissues for general and nitrogen metabolism throughout the animal. Analysis of the PCR-derived sequences of the extracted mRNA revealed - in addition to the GS cDNA previously cloned from liver - the presence of a second GS gene, exclusively expressed in gill tissue. The two proteins showed a relatively low sequence similarity; the closest relative amongst sequenced GSs was from *Xenopus laevis*.

These findings indicate toadfish GS gene duplication and diversification and confirm recent observations that the **rainbow trout** has at least four GS-encoding genes with differing levels of tissue expression and different metabolic pathways.

Walsh *et al.* suggest that gill GS traps toxic ammonia in this organ. This is analogous to the toadfish switching to ureotelic - it excretes urea in pulses from the gills, simultaneously shutting down the leakage ammonia that accumulates. The authors speculate that toadfish gill GS has a function that is closer to that of strictly ureotelic terrestrial animals i.e. avid ammonia scavenging. This could also help explain the similarity between the fish and frog genes.

References

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