RE-EXAMINATION OF NITROGENOUS WASTE EXCRETION IN SEVERAL MARINE TELEOST FISHES

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It is widely believed that the vast majority of marine teleost (bony) fishes are ammonotelic, that is, they excrete the bulk of their nitrogenous waste as ammonia. However, recent studies with the gulf toadfish (*Opsanus beta*) and several other teleost fish suggest that urea may contribute a substantial portion of nitrogenous waste in some fish species. Notably, the toadfish excretes greater than 90% of its waste nitrogen as urea in a single pulse per day from the gills lasting as little as 30 minutes (for review, see Walsh, P.J. *Ann. Rev. Physiol.* 59: 299-323, 1997). Given this dynamic pulsatile excretion, it is possible that prior surveys of marine fish, which typically measured excretion for only a few hours, could have missed such daily pulsatile events and substantially underestimated urea excretion. Additionally, one hypothesis for why toadfish make and excrete urea in a pulsatile fashion is that it might afford them a degree of chemical crypsis from predators and prey during non-pulse periods. We reasoned that if this is the case, other sit and wait ambush predators (exemplified by the goosefish which uses a lure to capture prey) might also be substantially ureotelic.

With this background in mind, we examined several benthic marine teleosts common to the MDIBL environs for evidence of urea excretion. Following capture, a short acclimation period (24 to 48h) to laboratory holding conditions at ambient temperature (~16°C) was allowed, during which time fish were not fed. Fish were then placed in a volume of seawater approximately 20 times their volume, and water was sampled continually using a peristaltic pump and fraction collector arrangement which changed sample tubes hourly. Water was replaced completely every 12 h, and sampling was continued for up to 48 h. Photoperiod was ambient, and temperature was maintained between 16-20°C. Hourly samples were examined for urea and ammonia concentration using previously established methods (Ivancic, I. and Deggobis, D. *Water Res.* 18: 1143-1147, 1984; Price, N.M. and Harrison, P.J. *Mar. Biol.* 94: 307-313, 1987).

Four fish species were studied representing primarily benthic lifestyles. In all of these species, ammonia was the predominant form of nitrogen excreted, with % ureotely ranging from only 11.0 to 16.8% of the total N excreted (Table 1). Values of nitrogen excretion were typical of other marine teleosts published previously. In all cases, both ammonia and urea concentration increased in the water in a linear fashion, with no evidence of excretion pulses.

Table 1. Ammonia and urea nitrogen excretion rates for several teleost fish common to the environs of MDIBL. Values are means ± S.E. (μmols N kg^{-1} h^{-1}).

Species	Ammonia Excretion	Urea Excretion
Myoxocephalus octodecemspinosus (Longhorned sculpin) (N = 5)	449.8 ± 40.4	75.3± 24.9
Scophthalamus aquosa (Windowpane flounder) (N = 3)	298.8 ± 35.6	60.1 ± 16.2
Cyclopterus lumpus (Lumpfish) (N = 3)	518.4 ± 87.2	63.8 ± 13.2
Lophius americanus (Goosefish) (N = 3)	727.8 ± 124.6	94.7 ± 15.9

These results allow us to conclude that benthic lifestyle in fish per se is probably not an important determinant of nitrogen excretion patterns. Further research with alternative hypotheses is needed.

Although urea makes up a relatively minor portion of nitrogen excretion in the fishes examined, further studies of the mechanisms of excretion may prove interesting. Indeed, the cDNA for a specific urea transporter (homologus to the mammalian kidney UTA gene) has been isolated and characterized from toadfish gill (Smith, C.P., M.J. Heitz, C.M. Wood and P.J. Walsh. *J. Physiol.* 511: 33P, 1998). Frozen gill tissue samples have been obtained from the species in this study which will be analysed for the presence or absence of a homologous transporter.

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