Elucidating spatiotemporal infection biology of *Loma morhua* (Microsporidia) in Atlantic cod (*Gadus morhua*) through integration of parasitological and molecular quantitative diagnostic approaches relevant for aquaculture disease mitigation

Abstract

Assessment of Atlantic cod (*Gadus morhua*) as an alternative aquaculture species was driven by socio-economic consequences following collapse of the wild fishery. Cod aquaculture failed in North America due in part to emergence of a known but poorly characterized microsporidian pathogen. Microsporidia are fungal parasites with almost ubiquitous distribution among wild fishes, but typically inconsequential infections. However, finfish aquaculture supports epizootics due to high host density, abiotic stressors, and high biotic potential of these parasites. Consequences of *Loma morhua* infections in cultured Atlantic cod are undefined. Therefore in this thesis, reliable and integrative methods for *L. morhua* detection, identification, and quantification have been developed to support empirical assessment of strategies to mitigate its effects during aquaculture. Spatiotemporal investigations documented the spleen as the most reliable host organ for parasite detection and quantification throughout infections. A hatchery epizootic revealed variable spleen infection among 50 Atlantic cod families. Fish growth was inversely correlated with infection intensity, and 14% fillet loss occurred in those individuals most susceptible to *L. morhua* infections. Whereas specific genetic markers remain elusive, broodstock selection is supported as a mechanism to help limit disease during culture. The effect of parasitism on growth was also documented experimentally with parasitized fish showing 19.3% fillet loss compared with uninfected controls. An integrative approach for parasite detection incorporated parasitological methods and a quantitative PCR (qPCR) assay developed according to Minimal Information for Quantitative Experiments guidelines. This integrative approach revealed intraperitoneal spore injection as an efficient model that both mimics epizootic infection dynamics and infects 100% of fish. Occult subclinical infections detected in 31.8% of fish promote qPCR as the new gold standard for *L. morhua* detection. This qPCR assay and integrative approach improves diagnostic and analytical sensitivity in detecting microsporidian infections, supports empirical assessment of preventative and therapeutic treatment of infections, and promotes studies to identify genetic markers for selection of broodstock that resist microsporidian disease. In summary, this work provides a foundation for investigation of host-parasite interactions and basic microsporidian biology that supports the development of rational mitigation strategies for this and other pathogens as aquaculture diversifies to include alternative finfish species.
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Publications:


Selected Conference/Workshop Proceedings (1 of 4):


Selected Conference Presentations/Invited Seminars (5 of 5):


Frenette, A. P., M. S. Duffy. 2012. Loma morhua in Atlantic cod: Efforts to mitigate infections during aquaculture. Invited seminar to the Department of Biological Sciences, Queen’s University Belfast, Belfast, Northern Ireland, U.K., May 24.