

Ultrastructure of *Nucleospora cyclopteri*, an intranuclear microsporidian infecting the Atlantic lumpfish (*Cyclopterus lumpus* L.)

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Abstract

Nucleospora cyclopteri is an intranuclear microsporidian parasite that has recently been described infecting wild Atlantic lumpfish from Iceland. A similar report was previously made from captive lumpfish in Canada, but it is not currently known whether the same parasite is responsible for both infections. Here we present new ultrastructural data on the Icelandic parasite in order to make direct comparisons with the Canadian report. Mature spores are elongate ovoid, contain a single nucleus, an isofilar polar filament with 10-12 turns and measured 2.53 × 1.04 µm. The earliest developing stages observed were sporogonial plasmodia that contained aggregates of electron dense structures typical of microsporidia from the Enterocytozoonidae. These spore characteristics are almost identical to the Canadian form and both manuscripts report degenerate lymphocytes and comparable developing plasmodial stages. Due to these close similarities, we conclude that the same parasite, *Nucleospora cyclopteri*, is responsible for causing disease in both Canadian and Icelandic lumpfish populations.

Introduction

Nucleospora cyclopteri is an intranuclear microsporidian, from the Enterocytozoonidae, that has recently been described associated with serious kidney pathology from wild caught Icelandic lumpfish (Freeman et al., 2013). A similar microsporidian infecting captive lumpfish in Canada was reported by Mullins et al., 1994. However, it has not been possible to confirm the same parasite is responsible, as the Icelandic report focused on histopathology and DNA sequence data but did not include ultrastructural analyses. Here we provide information on the ultrastructure of Icelandic *N. cyclopteri* and compare that to the original Canadian report.

Methods

Kidneys with gross signs of infection by *N. cyclopteri*, were removed from two freshly captured spawning female fish from Húnaflói Bay in northern Iceland (66° 3'37.29"N, 20°28'18.31"W) during April 2012 and prepared for Transmission Electron Microscopy (TEM). The fish measured 40 & 44 cm in total length and were also used for the molecular characterisation of the microsporidian (data not shown; see Freeman et al., 2013 (fish 9 & 10)). Dissected kidney tissues were fixed in 2.5% glutaraldehyde for 4 hours and washed in three changes Sorenson's buffer (0.1M, pH 7.4). Samples were then post-fixed in 1% osmium tetroxide

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