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Protein wasting and oxidative damage in the spawning land-locked three-spined stickleback due to *Schistocephalus solidus* invasion

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Abstract

Three-spined stickleback, *Gasterosteus aculeatus*, due to euryhalinity, inhabits marine and freshwater environments migrating to the coastal areas for spawning. Spawning is an energy-demanding life cycle period for any fish species, including those of a land-locked stickleback subpopulation inhabiting a freshwater lake of the White Sea basin. Besides, parasite infestation also compromises the welfare of stickleback, a second intermediate host for *Schistocephalus solidus*, via behavioral and feeding abnormalities. Both the spawning and parasite invasion exhaust fish thus threatening the spawners' viability. In order to discriminate the effects of spawning and parasites on host metabolism and the mechanisms of muscle degeneration, the protein-degrading enzymes and oxidative stress biomarkers, including carbonylated proteins and the antioxidant system, were evaluated in the organs of spawning *G. aculeatus* both invaded and non-invaded with *S. solidus.* In parasite-invaded fish, a substantial decrease in total body weight and losses of the skeletal muscle proteins were revealed. Besides, oxidative damage of tissue proteins (measured by protein carbonyls) and subsequent activation of the protein control machinery, including the autophagic and proteasome systems, were detected in the liver and muscles of infected individuals. *Schistocephalus*-induced effects on a host, such as oxidative stress and toxicity, were revealed through the induction of antioxidant enzymes, such as glutathione transferase, and low-molecular agents in fish liver. Summarizing, both the exhaustion of skeletal muscle reserves and significant oxidative damage of the vital macromolecules are involved in the mechanisms of parasite-induced abnormalities in stickleback protein metabolism. On the other hand, the mobilization of muscle protein depot and amino acid utilization in the energy production pathways maintain the individual viability of stickleback, particularly during spawning. The study was supported by the budget funding by theme 0218-2019-0076.

Keywords

spawning, three-spined stickleback, host-parasite, muscle proteolysis