Unveiling a salmon killer's secrets

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Many microorganisms have evolved to parasitize the intestinal tract of animals. One of them, *Spironucleus salmonicida* - the so called the 'salmon killer' - is specialized in infecting salmon's digestive system. Given the opportunity, *Spironucleus* can enter the host's bloodstream and spread throughout the body causing systemic spironucleosis. Amongst the pathological symptoms of systemic spironucleosis are enteritis, skin lesions, enlarged spleen, internal haemorrhage and anorexia. Systemic infection by S. *salmonicida* can cause mortality of the fish. The aquaculture industry has suffered significant economic losses due to spironucleosis outbreaks in the past years. The only known treatment for this parasite is an antibiotic called metronidazole (MTZ) which targets the antioxidant defense of the parasite and irreversibly damages the cell. MTZ has carcinogenic effects on humans and is subsequently under strict usage restrictions, thus making the control of *Spironucleus* extremely hard.

Spironucleus naturally inhabits the intestinal tract, where oxygen is rare. Like its close relatives, *Spironucleus* can produce energy in the absence of oxygen. This ability comes with the price of being sensitive to oxygen. Due to this oxygen sensitivity, *Spironucleus* should not be able to survive in oxygen rich tissues. But, as stated earlier, during systemic infection, *Spironucleus* spreads throughout the body where oxygen concentrations are much higher than in the intestine. How does this this oxygen sensitive microorganism survive in oxygen rich environments?

To investigate how the parasite reacts in the presence of oxygen, I grew the parasite in three different growth conditions and subsequently analyzed what genes were expressed in different conditions. Normally, the parasite is maintained in a culture medium supplemented with antioxidants and devoid of oxygen; this served as a 'control' condition. I also analyzed the gene expression of Spironucleus cells exposed to atmospheric air for an hour and grown in medium without antioxidants. The results revealed a broad range of antioxidant enzymes that are working together in a complex pathway in order to turn the toxic oxygen into water but also to repair oxygen-damaged proteins. The parasite's reaction to both stress conditions was very similar but more intense in the exposure in atmospheric air. Previous studies computationally predicted that these proteins would be involved in oxidative stress response; however my work is the first to experimentally validate these predictions in Spironucleus. I suspect that at least some of these gene products have a fundamental role in the parasite's ability to cause systemic infections and spread in fish farms.

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