Novel water treatments for zoonotic pathogen Cryptosporidium

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Project description:
Cryptosporidium is an apicomplexan waterborne enteric parasite, causing diarrhoea in over 7.6 million children a year. Self-limiting in the healthy individuals, often fatal in immunocompromised or malnourished, the disease claims over 200 000 lives of under 2-year-olds per year only in developing countries. It is also a 'blue-marble' pathogen able to intrude into the developed world wherever breaches in surveillance or treatment of water supplies allow epidemics. With no treatment against it and no vaccine foreseeable in the near future, the only way to control Cryptosporidium is through water treatment. The transmissive stages, oocysts, are resistant to the classic chlorine treatment, and difficult to filter out of the water due to their small sizes. The only way treatment to inactivate them in drinking water is UV treatment, which also needs special equipment still missing in many treatment plants. Given its impact, it is little wonder that Cryptosporidium is treated as a bioterrorism agent, and the European Water Directive insists on shutting down the distribution plants should the oocysts be found in drinking water. Finding effective, economically efficient way of eradicating parasite from water supplies could significantly reduce the of disease burden both, in developed and developing countries. This interdisciplinary project will be based at Cardiff University and will combine the novel method of water treatment using microwaves developed at the School of Engineering with state-of-art Cryptospordium culturing facility based at School of Biosciences. Cryptosporidium oocysts will be exposed to microwaves, and the impact of this treatment will be experimentally tested in the in vitro system, using a range of phenotypic assays (viability, infectivity, motility and commitment; using modern microscopy and molecular techniques), transcriptomics (to identify upregulation and downregulation of housekeeping genes and transcription factors potentially disrupting life cycle) and electron microscopy (to identify ultrastructural changes in the host cell infection process). The quantitative data will be then used to build dose-response curves of different dilutions of oocysts in water, exposed for different times to a range of microwave intensities.

The student will acquire a range of cell biology and parasitological skills combining innovative approaches to water treatment; developing expertise in the unique culturing facility in Europe which integrates biphasic host-cell based cultures (including continuous hollow fibre and human gut representative systems) with axenic in vitro approaches allowing various phenotypic assays; training in transcriptomics and imaging (confocal, fluorescent and electron microscopy), as well as mathematical approaches to data interpretation.