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Sensor detection of parasite eggs and (oo-)cysts – possibilities and challenges

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To secure the safety and quality of food and water presence of pathogens including parasites must be controlled. This relies among other things on implementation of sensitive and specific tests which are able to rule out the occurrence of parasites. Worldwide environmentally resistant oocysts and cysts ((oo-)cysts) of the protozoan genera *Cryptosporidium* and *Giardia* are major causes of waterborne outbreaks of diarrhea. Methods for routine recovery and detection of waterborne *Giardia* and/or *Cryptosporidium* include filtration, immunomagnetic separation and detection by microscopy of immunofluorescence stained (oo-)cysts. These methods have low recovery rates, are time consuming, costly, and require well equipped laboratory facilities. Likewise, microscopy is the universal diagnostic method for detection of helminth eggs and protozoa in food and feed despite low sensitivity, difficulties to maintain quality control and common misdiagnosis. Novel optical techniques for high-resolution imaging and image transfer over data networks may offer solutions to these problems.

This presentation focus on results and experiences obtained from use of the FluidScope™ technology for online, real-time sensor detection of *Cryptosporidium* and *Giardia* in drinking water. This novel optical technique, in combination with advanced data analysis, yields a measure for the protozoal content present in a sample. High sensitivity of the system is acquired through a combination of a new, patented filtration system and ultrasound to obtain high recovery rates of apparently undamaged protozoa: 84.9% (Standard deviation (±) 4.8) for *Giardia* cysts and 70% (± 6.5) for *Cryptosporidium* oocysts. Ultrasound in the current system is tuned into a useful tool for enhanced elution of filtered (oo-)cysts. The combined use of a metallic filter, sonication and "air backwash" are key factors in the creation of this highly efficient and robust system which can be used continuously for extended time with minimal maintenance requirements. Sample acquisition and analysis is performed in real-time where objects in suspension are differentiated into e.g. *Cryptosporidium* spp., *Giardia* spp., organic and inorganic subgroups. Subsequently (oo-)cysts passing through the system are collected on a filter and may be used for further molecular characterization. The detection system is a compact, low power, reagentless device and thus ideal for applications where relatively long service intervals and remote operations are desired. The applications envisioned for this environmentally friendly system includes early warning of source water contamination e.g. water plants/water distribution networks, filtration systems (water purification), commercial buildings, swimming pools, and industry in general.

Development of highly specific algorithms for detection of *Cryptosporidium* and *Giardia* pose some challenges which will be discussed. For comparison newly developed, vision based systems for detection of helminth eggs in clinical samples and liquid suspensions will also be presented. These techniques, although not yet commercially available, offer promising options for future detection of parasites in food, feed and water even if further development is still needed before they can be used routinely.