USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Title: Miniaturized DNA Biosensor System for Detecting Cryptosporidium in Water Samples (year 2 of 2 continued)

Priority Problem Area: Water Quality Focus Category: Water Quality, Water Supply, Methods

Keywords: Cryptosporidium, drinking water, monitoring, DNA biosensor, waterborne pathogens, microfabrication, field screening, hand-held analyzer

Duration: 24 months: October 1, 1997 - September 30, 1999

1999 WRIP Award:

- Total: $16,258
- Direct: $11,449
- Indirect: $4,809

Principal Investigator: Joseph Wang, Department of Chemistry & Biochemistry, NMSU

Congressional District: New Mexico Second

Statement of Critical Resource Problem

This proposal addresses the urgent needs for a greatly improved analytical methodology for detecting Cryptosporidium parvun in water samples. The microbial pathogen Cryptosporidium has been recognized as a serious public health threat problem. Infections with this protozoan can lead to acute gastroenteritis and diarrhea, that can become life threatening in individuals with weakened immune systems. Cryptosporidium can spread in humans through direct contact, or through waterborne outbreaks. Due to this major health threat, there are growing demands for a routine test that reliably and rapidly detects the presence of Cryptosporidium in water supplies. Yet, despite of these major concerns and increasing efforts by the EPA, no analytical method satisfactorily detects the Cryptosporidium in water supplies.

The goal of this project is to develop, optimize and deploy a miniaturized analytical system for the rapid and reliable monitoring of Cryptosporidium in water samples. Such microsystem will be based on the couplingCon a silicon chipCof highly specific DNA hybridization Cryptosporidium biosensors and microfabricated PCR reactors. The resulting easy-to-use hand-held PCR/sensor system will address various deficiencies of current tests for Cryptosporidium, and should accelerate the realization of wide-scale screening for this deadly pathogen in water samples.

Statement of Expected Results and Benefits

The proposed development of modern DNA biosensors and their on-chip integration with miniaturized PCR reactors would allow testing for Cryptosporidium to be performed more reliably, rapidly, easily and inexpensively in environmental laboratories and field settings. Such introduction of an automated, user-friendly hand-held DNA analyzer will thus address various drawbacks of current tests for Cryptosporidium. It would also minimize the needs for operator training, circumvent operator bias, and addresses the limited resources (of numerous local municipalities). This effort will thus accelerate the realization of wide-scale monitoring of Cryptosporidium in water samples, and will benefit many organizations and users, including local municipalities, state water laboratories, and federal agencies. The minimal size, weight and power requirements of electrochemical devices should be particularly attractive for the field screening task.

Even though this effort is focused on the detection of the Cryptosporidium pathogen, it should be readily extended to other important microorganisms. Our preliminary investigations of DNA biosensors (including Cryptosporidium ones), and extensive experience in designing compact field-deployable analyzers, certainly support these expectations. The WRRI support should facilitate major external funding (from the US EPA), and will effectively train and motivate students in the areas of water quality and monitoring.