Detecting the Presence of Waterborne Chemicals: Alternative Water Tests for the South

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Dampen a piece of absorbent paper with a sample of untreated water. Place some buttercrunch lettuce seeds on the paper. Incubate them at room temperature for four to five days. Compare the length of the emerging seedlings or roots to those of seeds grown under normal conditions with potable water that is not chemically contaminated.

If the water is relatively free of contaminants, the seeds will grow at a normal rate, notes Barney Dutka, a scientist at Environment Canada's National Water Research Institute (NWRI) in Burlington, Ontario. But if the water contains elevated levels of toxic chemicals, the seedlings may not grow, the roots may not grow, or the seeds may fail to germinate. "You can get a variety of reactions depending on what chemicals are present in the water and at what concentrations."

This and other simple 'bioassays' were featured at a water testing workshop held last winter in Cornwall, Ontario. Organized by the International Development Research Centre (IDRC), the workshop brought scientists from several countries together to practice alternative testing methods and pave the way for their eventual use in the South.

Larger problem

According to Dutka, the presence of chemical contaminants in drinking water supplies is a larger problem in some parts of the world than the presence of microbiological contaminants such as bacteria and viruses. Exposure to waterborne chemicals such as pesticides, herbicides, and heavy metals can have a severe impact on human health, causing health effects ranging from dizziness and tunnel vision to extensive neurological damage.

Although commercial water tests are available, they are relatively time-consuming and beyond the means of most developing countries. For example, to test river water samples for 50 different chemical substances could cost between CA$5,000 and $10,000 — an amount that far exceeds the per capita income in many countries. By comparison, a 250-gram package of buttercrunch lettuce seeds — enough for 50,000-100,000 tests — costs about CA$30.

Different ranges

Unlike standard commercial tests, which identify and measure the concentration of chemical contaminants in water, the alternative tests measure the actual effects of toxic compounds or mixtures of compounds present in water, and are designed to be used collectively. "These tests are not the most sophisticated and they're not the most sensitive, but they will react just as well as the most expensive commercial tests," says Dutka. "They all have different ranges, which is why you use a group of tests. Not all bioassays respond to the same chemicals in the same way."

IDRC's interest in homegrown chemical tests evolved out of previous work in Chile. "We went down there in the early 1990's, collected samples from different areas, brought the sediments and waters back to Canada, and conducted bioassays on them. We found that every water sample contained some toxic chemicals and a lot of the chemicals were pesticides," he recalls.

Water testing workshop

In 1996, IDRC hosted a workshop in Ottawa to assess various tests for drinking water toxicity and identify the most appropriate ones with the help of experts from Canada and the South. "We selected a battery of tests based on simplicity, inexpensiveness, and the possibility of performing them under developing world conditions," he says. In addition to the buttercrunch lettuce test, the participants chose methods involving onion bulbs, microscopic worms, freshwater crustaceans, and freshwater polyps.

Seven months later in Cornwall, scientists from Argentina, Chile, Colombia, Costa Rica, India, Mexico, Turkey, and Ukraine came together to learn now to conduct the different bioassays. They then returned home with the cultures and supplies needed to perform them in their own laboratories. The scientists are now participating in an IDRC-supported intercalibration exercise coordinated by the NWRI. Over the next year, each investigator will receive six series of unidentified water samples containing toxic chemicals and will analyze them using the different bioassays. Their results will be used by NWRI to determine how the different tests perform in each laboratory, and in relation to each of the chemicals or mixtures of chemicals.

Science projects

This exercise will likely be followed by field trials in which investigators analyze locally obtained water samples. IDRC also plans to invite schools from around the world to take part, through science projects for students. Participants could be linked through the Internet, allowing scientists and schoolchildren to compare notes about global water conditions.

According to Gilles Forget, Senior Scientist at IDRC, the potential benefits of these alternative tests extend well beyond the laboratory. "In the hands of local communities, they can be powerful tools, enlightening them of the need to protect their own environment," he explains. In addition to showing whether their drinking water is safe, test results can help communities to lobby for pollution controls and to adopt more sustainable farming practices.

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