New test to detect arsenic contamination in drinking water

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Bacterial pigments. Credit: Jim Ajioka

An economical and easy-to-use biosensor could reduce the chance of being poisoned by arsenic – a common contaminant of wells in parts of Asia.

Arsenic is one of the most common elements on Earth and is present as arsenic salts in all water. The World Health Organization sets the safe level for arsenic in drinking water at 10 parts per billion. From the Himalayas to Southeast Asia, arsenic levels in drinking water can be more than 10 times that amount, yet the wells are rarely tested. The problem has been termed “the largest mass poisoning of a population in history”, with calls for a reinvigoration of moribund well-testing campaigns.

For instance, of the more than 400,000 shallow tube wells in Nepal, it is

estimated that nearly 10% of them are contaminated with arsenic, which can cause a variety of health problems, including skin lesions, diseases of the blood vessels of the hands and feet, and cancer of the skin, bladder, kidney and lung.

Several arsenic testing kits are available on the market, but they require expensive machinery to read the outputs, and almost all of them use mercury bromide, which is extremely toxic.

Dr. Jim Ajioka from the Department of Pathology, along with Dr. Jim Haseloff from the Department of Plant Sciences and colleagues from the University of Edinburgh, has designed a whole-cell arsenic biosensor that is cheap, non-toxic and easy to use.

Some species of bacteria are natural arsenic biosensors: in the presence of less than 10 parts per billion of arsenic, they initiate the production of enzymes and an efflux pump for the detoxification and removal of arsenic. For the sensor, the team will take the genes that detect arsenic and combine them with bacterial genes that produce coloured pigments. The modified bacteria will turn green when arsenic levels are safe, and purple when arsenic levels are unsafe. The test uses a harmless strain of the soil-dwelling bacterium Bacillus subtilis, which poses no threat to human health or the environment.

The extremely simple visual output combined with the low cost (estimated at around $0.50 per test) and the lack of need for any expensive monitoring equipment make the whole-cell arsenic biosensor ideal for use in the rural areas where arsenic contamination of drinking water is widespread.

With the assistance of Cambridge Enterprise, the University's commercialisation arm, the team has received a translational grant from the Wellcome Trust. It is anticipated that a functioning device can be

built within the next 18–24 months, with field testing to follow.

Provided by University of Cambridge