Finding an Antidote to Poisoned Water

THE ISSUE
In Bangladesh and parts of India, low levels of arsenic in the drinking water are causing what has been termed “the world’s worst mass poisoning.” At the lowest estimate, 57 million people are affected. The arsenic responsible is unavoidable—it occurs naturally in the wells the people rely upon for all their drinking and cooking needs.

“Symptoms start with dark patches on the skin and progress to worsening lesions, skin and internal cancers and eventually death,” says Ingrid Pickering, Canada Research Chair in Molecular Environmental Science.

She and her husband Graham George, U of S Canada Research Chair in X-ray Absorption Spectroscopy, and their international collaborators were determined to figure out why well water in countries like Bangladesh was making millions of people sick.

THE CHALLENGE
Effectively removing arsenic from the water or bringing clean water from other sources is costly and challenging.
THE RESEARCH

Though Agatha Christie is known for her liberal use of arsenic in her plots, she never used this curious property: though both arsenic and selenium ingested in large enough doses are lethal, a lethal dose of certain forms of arsenic can be completely counteracted by a similar dose of selenium. This relationship has been known for several decades, but just how this occurs has been a long-standing chemical puzzle.

George, Pickering and their collaborators used synchrotron light—such as will be available at a new beamline under construction at the Canadian Light Source synchrotron—to uncover the mechanism: that is, a molecule containing one atom of arsenic bound to one atom of selenium forms in the body and is rapidly excreted, taking both elements with it.

The researchers realized that their findings could be significant for people in countries like Bangladesh. The afflicted areas are very low in dietary selenium, an essential element that, amongst other things, helps protect against cancer.

The researchers began to wonder: What if the Bangladeshis weren’t actually suffering from arsenic poisoning, but rather arsenic from the drinking water was eliminating the already scant selenium in the body, making the population highly selenium-deficient. Could the Bangladeshis actually be suffering from acute and chronic selenium deficiency, whose symptoms resemble that of arsenicosis?

An American-led Phase III clinical trial has tested the effect of adding selenium supplements to the diet of people in afflicted areas. Using a synchrotron at Stanford in California, George, Pickering and their collaborators have investigated blood from patients treated with the supplements, looking for the arsenic-selenium molecule.

THE IMPACT

So far, results look highly promising that a selenium-enhanced diet could provide the solution. And while the rural Indian and Bangladeshi population may be resistant to a nutritional supplement in the form of pills, selenium in a dietary staple such as lentils may be welcomed.

That’s where Saskatchewan, as a world-leading exporter of lentils, and the U of S, home to a renowned centre for crop development and to Canada’s only synchrotron, may be able to play a role.

“Saskatchewan soils are rich in selenium and so are the lentils which are grown on them,” says Pickering.

“It could be that a Saskatchewan crop and the synchrotron measurements hold the key to health for people on the other side of the world.”