Simple water test could prevent crippling bone disease

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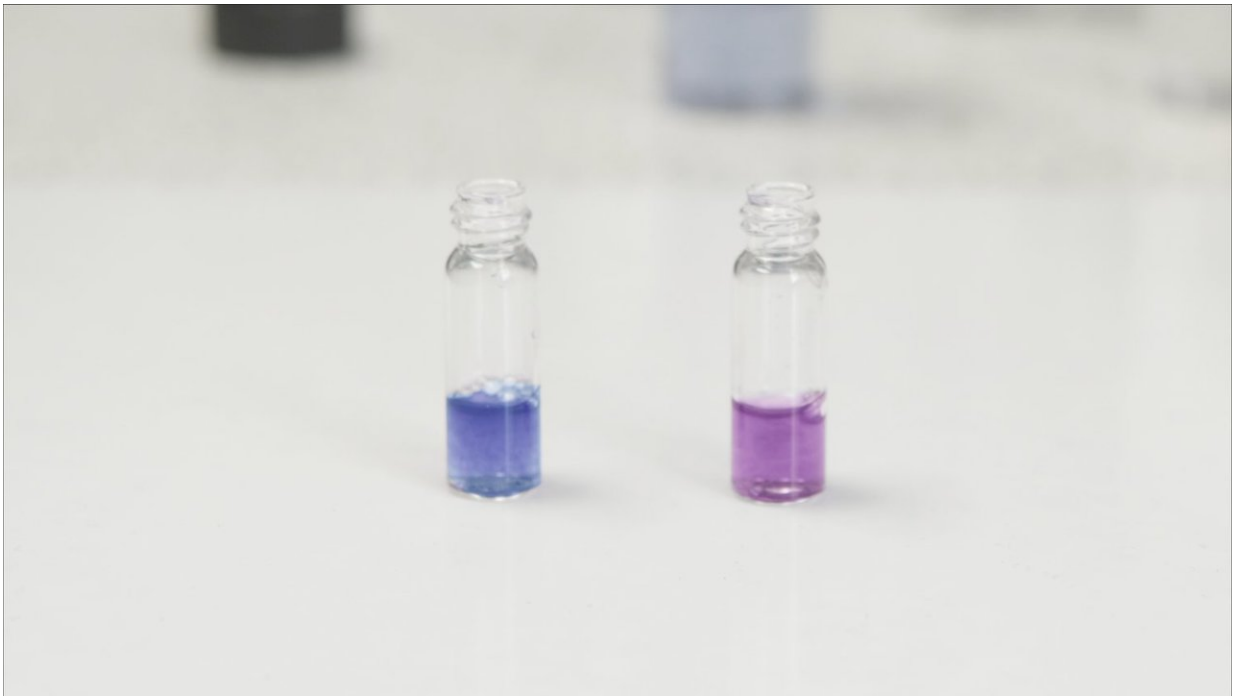

The simple test changes color from purple to blue when fluoride levels are too high. Credit: University of Bath

A simple colour-changing test to detect fluoride in drinking water, devised by researchers at the University of Bath, could in the future prevent the crippling bone disease, skeletal fluorosis, in developing countries such as India and Tanzania.

Whilst low amounts of fluoride are beneficial for healthy teeth, high levels of fluoride can weaken bones, leading to skeletal fluorosis. This disease causes crippling deformities of the spine and joints, especially in children whose skeletons are still forming.

When water passes over certain minerals, it can dissolve fluoride, which results in elevated levels of fluoride in drinking water sources in parts of East Africa, India, China and North America.

Levels of fluoride in drinking water are routinely monitored and controlled at treatment works in developed countries. However in areas of the world where there is no piped water system or treatment works, people rely on drawing untreated water from wells, which can often be contaminated with higher than recommended levels of fluoride.

The amounts of fluoride in the groundwater can vary due to weather events, with levels fluctuating hugely when there is a lot of rain.

A research team at the University of Bath's Centre for Sustainable Chemical Technologies, and the Water Innovation and Research Centre (WIRC), led by Simon Lewis, has developed a simple colour-changing test that detects high levels of fluoride quickly and selectively.

Whilst the test is at the proof of concept stage, the team aims to develop it into a disposable test strip that is low cost and easy to use by anyone.

Dr Lewis said: "Whilst a small amount of fluoride is good for your teeth and prevents tooth decay, high levels are toxic and can cause crippling deformities that are irreversible.

"Most water quality monitoring systems need a lab and power supply and a trained operator to work them. What we've developed is a molecule that simply changes colour in a few minutes which can tell you whether

the level of fluoride is too high.

"This technology is in the very early stages, but we'd like to develop this technology into test strips, similar to litmus paper, that allow people without any scientific training to perform a test that is low cost, rapid and robust.

"We anticipate that in the future it could make a real difference to people's lives."

Co-investigator Dr Jannis Wenk, of the Department of Chemical Engineering and Water Innovation and Research Centre (WIRC) at Bath said: "I am very enthusiastic about the newly developed indicator molecules and am convinced that they can be incorporated into an easy to use technology that is able to provide instant information on the safety of drinking water with regards to fluoride."

The Bath researchers are partnering with the Nasio Trust, a charity that works to protect and support vulnerable children in East Africa, to develop their system for ease of use in the field.

Director of the Nasio Trust, Nancy Hunt, said: "For decades, people living in Oldonyosambu area of Arusha Tanzania East Africa, have been drinking water with naturally occurring levels of fluoride that can reach over sixty times the US recommended level.

"This has had a severe impact on the lives of people in this poor community, causing crippling skeletal fluorosis, chronic pain and poor cognitive development in children.

"Working in partnership with the University of Bath, this new technology will provide the Nasio Trust with a simple, affordable method to test fluoride levels which will enable us to identify, remove or

reduce the cause of the fluoride problem and provide safe drinking water to further improve the quality of life and long term health outcomes for the community of Oldonyosambu."

The team is now looking for additional partners to take the technology forward and help develop the test. They are also working towards adapting the technology to other types of notorious water contaminants of global concern, including mercury, lead and cadmium.

More information: Carlos M. López-Alled, Adrian Sanchez-Fernandez, Karen J. Edler, Adam C. Sedgwick, Steven D. Bull, Claire L. McMullin, Gabriele Kociok-Köhn, Tony D. James, Jannis Wenk and Simon E. Lewis "Azulene-boronate esters: colorimetric indicators for fluoride in drinking water", *Chemical Communications*, 2017, DOI: 10.1039/c7cc07416f

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