

Engineering safer drinking water in Africa

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In the United States and other developed countries, fluoride is often added to drinking water and toothpaste to help strengthen teeth. But too much naturally occurring fluoride can have exactly the opposite effect.

Large amounts of fluoride can lead to dental fluorosis and skeletal fluorosis.

"Dental fluorosis is a darkening or mottling of the teeth, and you can tell very easily when people smile, because their teeth will be dark and discolored," says Laura Brunson, [environmental scientist](#) at the University of Oklahoma (OU) in Norman, Okla.

While [dental fluorosis](#) is not painful, it can have a dramatic effect on an individual's ability to get a job or find a spouse.

"They may have a harder time finding some type of public service job. And there is sort of a [social stigma](#) attached to it, a poverty stigma," says Brunson.

Skeletal fluorosis is much more debilitating.

"We saw some women in India who were physically unable to put their hands behind their heads. Some skeletal fluorosis can come with pain associated with it as well, and children sometimes end up with bowed legs or deformed knees or arms," says Brunson.

With support from the National Science Foundation (NSF), Brunson is

working on methods of removing fluoride from [drinking water](#), using tools and raw materials readily available in local communities. Brunson and her team recently returned from a month of fieldwork in Ethiopia, where they tested filtering methods using charred bones and charred wood.

"We'd prefer to find filtration materials that don't have to be shipped in from another country, and that are inexpensive," says Brunson.

"We took materials, such as bone char and aluminum-coated bone char that we've worked with in the laboratory for quite a while, to Ethiopia and did continuous flow studies in that setting to see what would happen under more realistic conditions," she explains.

Brunson says the need to understand and incorporate local cultural considerations is just as important as the technical tools needed to remove fluoride or other toxins like arsenic.

In some communities, she notes, using bone char is not an option because people are not willing, for religious reasons or cultural reasons, to use [water](#) that's been filtered through bones. So then, more questions need to be asked. "What would be acceptable to you? Would wood char be acceptable as opposed to bone char because it's not an animal product?" Looking at those kinds of things," says Brunson.

The team included OU anthropology professor Paul Spicer, OU Health Sciences Center graduate student Andrew Borgstrom, and experts from Addis Ababa University in Ethiopia.

"We were able to do a couple of community surveys, trying to talk to people about, 'What do you think of your water, how do you use water, where do you get it from, what do you think about the current treatment system, is there something you would prefer to have? And how could

this treatment system be more convenient for you to use this water for drinking for your family,' asking those types of questions," says Brunson.

She is beginning a study of the use of plant waste material as a possible filter material, testing char made from the grain teff. Teff kernels are used in the production of injera, the staple bread of Ethiopia.

Brunson says many water projects in Africa that were started by well-meaning organizations are, unfortunately, not showing long-term success.

"Reports estimate there are nearly 200,000 wells across Africa that have been dug and implemented by well intentioned organizations. They raise money, they go to Africa, they drill a well; the community has water. That's great. And then they leave and then six months later, two years later, for whatever reason, the well breaks. It runs dry, there's a tiny part that breaks and no one knows how to repair it. It doesn't work anymore, and people are back to drinking contaminated water out of a river or a lake," she says.

As an instructor at the Price College of Business at OU, Brunson also brings a business and marketing aspect to her clean water research. She's trying to find ways to make clean water solutions sustainable and locally controlled.

"For example, if it's someone's livelihood to sell those bone char filters, it's doing two things. It's getting bone char filters to people that need to have water that's treated for fluoride. So it's great for those people, but then, it's also growing the local community economy and helping the person who's running that business make a living. Then, that person has the motivation to keep charring the bones, to keep talking to the community members about why it's important for them to treat their water and to keep purchasing the bone char so that their children and

their families have treated drinking water," says Brunson.

She also sees excitement from her students in developing long-term answers.

"I have them write journals to reflect on some of the things they're learning in class, and I ask them, 'If you were going to start a social entrepreneurial venture, what would you do?' And I start getting some really interesting answers. They realize, I am really passionate about this, and I could really make a difference through this, while still being an entrepreneur," says Brunson.

And, she says, clean water can have a much more dramatic impact than just eliminating disease. According to the United Nations, 884 million people around the world do not have access to clean and safe drinking water.

"If you can get people a water source that's safe and much closer to home, you save so much time. Frequently, the burden of collecting fresh water for drinking and cooking falls on girls and women. So, with a clean and close water supply, then girls are able to spend more time going to school. Women are able to spend more time doing family improvement activities," says Brunson.

There is also a big health improvement, if people are not suffering from diseases caused by arsenic, fluoride, or parasites.

"Kids are able to go to school and learn much better if they don't have worms and diarrheal disease. Parents are able to go to work more often. So, there are huge economic and education benefits," says Brunson.

The University of Oklahoma's College of Engineering is home to the WaTER Center (Water Technologies for Emerging Regions). In addition

to research on the removal of toxins like fluoride and arsenic, the center studies techniques such as passive wetland treatments for improving water quality, and also how climate change and drought might impact water cleanup.

Science and social entrepreneurship: Coming together to make affordable, safe water available to millions.

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