'Miracle tree' may form basis for low-cost water purification

September 17 2010

The moringa oleifera tree, often called the "miracle tree" for its potential to provide food, fuel and water in harsh environments, is the target of a new effort by three Penn State engineers to provide clean drinking water to the developing world.

The work, funded by a yearlong, $10,000 Environmental Protection Agency P3 grant, seeks to optimize a water treatment process involving the moringa seed.

"The seeds of the tree contain proteins," said Darrell Velegol, professor of chemical engineering and the principal investigator. "One of them is a cationic protein, a positively-charged protein that contains a little peptide sequence that acts like a molecular knife, which goes through the bacterial cell wall and kills it, basically slitting it open. We have data showing that for one type of E. coli bacteria, the moringa proteins not only take the bacteria out, but kill the bacteria too."

Because the moringa protein is positively charged, it is able to wrap up sediment in water, which is mostly negatively charged, allowing the sediment to settle out quickly.

"So the purpose of the grant is to identify what range of pathogens in water, whether it is a giardia protozoan or a pathogenic bacteria, the moringa tree protein kills," Velegol said, "and identify the capacity of a certain amount of moringa seed in removing the sediment and the pathogens from the water."

This summer, Velegol, along with his wife Stephanie Velegol, instructor in environmental engineering and a co-principal investigator, and Richard Schuhmann, the Walter L. Robb Director of Engineering Leadership Development and also a co-principal investigator, journeyed to Tiout, Morocco, to assess the tiny village's water supply and to get a better understanding of the people and culture they hope to assist.

"People are a central aspect of this grant because when you bring a technology like this into a place like Tiout, or Port-au-Prince, Haiti, or wherever, you need a technology that the people find locally acceptable and feel they can do," Darrell Velegol said.

The team found that the village had a clean water supply by standards in the developing world, but did not get the opportunity to test for bacteria or other biological contaminants. However, a sanitary survey indicated that hygiene problems might reside with the storage of water subsequent to pumping.

"This moringa grows naturally in harsh environments like the Moroccan desert," Stephanie Velegol said. "It's not a toxic chemical that we're bringing in that we have to dispose of. In addition, we believe moringa can bring prosperity to the people because it's not only something for food and water purification. Oils within its seed can be sold at a profit. So we thought it was a perfect mix."

She also noted that moringa leaves contain a large number of vitamins, minerals and proteins and can be fed to children to stave off malnutrition.

Schuhmann added that villages such as Tiout typically must truck in their water purification chemicals from distant cities, which can be costly. With moringa, "they can actually grow their own water treatment chemicals right here in the village," he said.

The idea to use moringa to purify water is not new. The problem for researchers is the fact that water purified by moringa seeds does not stay clean for very long.

"There are other proteins and organic matter in moringa seeds -- they act like food," Darrell Velegol said. "So any bacteria that are in the air and fall into the water will start to grow, so you can only store the water for about a day."

To extend the shelf life of water cleaned by moringa seeds, the researchers are experimenting with crushing moringa seed to water, so that the proteins go into the water. Sand is then added so that the active protein in the solution anchors onto the sand. The rest of the proteins and organic matter are rinsed away.

"The functionalized sand is now active, and we have data to show that it can clean water and kill pathogens," Darrell Velegol explained. "When you're done, you just let the sand settle out of the water, so that the sand can be used again."

Provided by Pennsylvania State University