(From left) Dr Wong Ka Lun, Prof Tan Swee Ngin and Prof Jean Yong are part of the team which found that silver ferns and brake ferns can reduce arsenic levels in water to WHO's recommended limit of 10mcg/l or less. ST PHOTO: DESMOND FOO

Ferns native to Singapore able to filter out arsenic

NIE team finds cheaper and easier way of removing toxin from water

By CAROLYN KHEW

SILVER ferns and brake ferns are more than just plants that decorate the gardens.

They are capable of making water safe for drinking by filtering out toxic arsenic, researchers have found.

The team from the National Institute of Education (NIE) found that the two types of ferns – both native to Singapore – were able to "hyperaccumulate" arsenic.

Greenhouse experiments showed that the plants were capable of reducing the level of arsenic in water to 10 micrograms per litre (mcg/l) or less. The World Health Organisation's (WHO) recommended limit is 10mcg/l.

"We wanted to find a sustainable method to help those who are in developing countries," said Associate Professor Tan Swee Ngin from NIE's Natural Sciences and Science Education Academic Group, who is one of the researchers. "For those who are poorer, they may not be able to afford the expensive filtration systems."

Current methods for removing arsenic from water include the use of special adsorbents and filters which are either expensive or require high maintenance.

In contrast, silver and brake ferns are more cost-efficient and easier to maintain – they need only be trimmed every month. When the ferns are no longer able to filter out the arsenic, they have to be disposed of in special bags for hazardous materials to prevent the toxin from leaching out.

Associate Professor Jean Yong, who was also involved in the research, said the ferns have certain enzymes that make the colourless arsenic less harmful to the plant, or even convert the toxin into something useful that the plant can use.

Arsenic is a trace metalloid that can be naturally occurring in soil or geological materials like volcanic rocks and stones used for landscaping, said Prof Yong, who is now with the Singapore University of Technology and Design. Arsenic can become harmful once it crosses safety limits.

According to the WHO website, inorganic arsenic compounds, such as those found in water, are highly toxic, while organic arsenic compounds, like those found in seafood, are less harmful to health. Long-term exposure to inorganic arsenic, mainly through contaminated water and food prepared with the water, can cause harmful effects such as skin cancer, said the WHO.

Arsenic can leach off naturally over time from concrete found in buildings and geological materials, which can "contribute to the inevitable increase in external arsenic concentration around very urbanised places", said Prof Yong.

In Singapore, more than 350,000 tests are conducted annually on more than 300 parameters, including arsenic, to ensure that water here is safe for drinking, said national water agency PUB.

Said a spokesman: "PUB's drinking water is well within the WHO Guidelines for drinking-water quality and is safe for drinking directly from the tap.

"In reservoir raw water, arsenic is usually undetectable or occasionally detected at trace levels (less than 8mcg/l). Our water treatment process is able to remove arsenic and it is not detected in our drinking water."

While arsenic in water is less of a worry in Singapore, as an added measure to keep water clean, silver and brake ferns can still be planted along reservoir banks to remove arsenic run-off, said Prof Yong.

The NIE study also found that low-cost iron oxide nanoparticles from rust can take up arsenic even more efficiently. The researchers found that a piece of cotton wool coated with rust solution can reduce the arsenic level in water from 50mcg/l to below 10mcg/l.

Prof Tan said she hopes the team can test the experiment findings in arsenic-contaminated sites in other countries.

"We hope to conduct more extensive arsenic remediation trials using real samples in the field," she said, adding that funds will be needed for manpower cost, chemical analyses and for securing experimental sites overseas.

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