O
er the past decade, with most of the fresh water sources of the world becoming polluted, countries round the world are faced with acute water shortages. Raw water from rain harvesting tanks, rivers, wells, lakes and sea may have to be increasingly purified by using a variety of expensive and energy consuming technology including mechanical filtration, chemical and biological treatment processes, reverse osmosis, desalination, distillation, etc.

Sadly, sufficient funds for building, operating or maintaining costly water treatment plants for supplying clean water are hard to come by.

In water treatment plants, both physical and chemical methods are used for purification of turbid raw water – filtration and chemical coagulants. At very high turbidity, when the water contains high levels of sand, clay, debris etc., it can no longer be adequately mechanically cleaned by using only filters. Coagulants are applied to transform water constituents into forms that can be separated out physically.

In large-scale treatment plants, Aluminum Sulphate (alum) is used as a conventional chemical coagulant. However, the high cost of the chemicals, equipment and technical expertise along with other problems impede use of alum for water treatment in impoverished countries.

The ideal alternative, inexpensive and environmentally safe method would be to use the extracts of seeds from the “drumstick” tree or Moringa oleifera for purifying and removing toxins like dyes, arsenic, lead, zinc, cadmium, etc. from waste water.

Versatile Drumstick Tree
The Drumstick tree has been cultivated for centuries in most countries of the tropics and its leaves, fruits, and roots used for food, animal feed and medicinal purposes. The plant belongs to the family ‘Moringaceae’, a single-genus family with 14 known species of which nine species are indigenous to Africa, two to Madagascar, one to Arabia and two to India.

While in India it is commonly referred to as “Moringa” (from Tamil Murungakai), the tree is also popularly known by other names like benzoilive, horseradish or drumstick tree, kelor, marango, mlonge, mulangay, nébéday, saijhan, and sajna or Ben oil tree. It is so versatile that Dr. David Odee, Head of the Biotechnology Division, Kenya Forestry Research Institute, in Nairobi, Kenya once hailed it as ‘one of the world’s most useful plants’.
Environment Friendly Drumstick

An article, “Plant that purifies: the drum stick tree” (Science Reporter, September 1990), reported how scientists at the University of Leicester, UK, had added dry drumstick or *Moringa oleifera* seed suspension to river water. They observed that water-soluble proteins which were formed made individual particles of material cling together to form a ‘floc’ which then trapped bacteria and virus. This action was similar to the formation of floc by applying alum (aluminum sulphate) to water, a process widely used in industrialized countries.

Laboratory studies show that six different species of drumstick trees display natural coagulant (primary coagulant) properties which could be used in household water treatment as well as in community water treatment systems and as an alternative to conventional coagulants. The seed kernels of drum stick tree contain significant quantities of low molecular-weight, water-soluble proteins which carry a positive charge. When the crushed seeds are added to raw water, the proteins produce positive charges acting like magnets to attract the predominantly negatively charged particles like clay, silk, bacteria, and other toxic particles in water. The proteins bind the negative charges forming ‘flocs’ or collection of dirt, soil, bacteria and other particles which are present in the water. These flocs are then allowed to settle and be removed by filtration. The extract works well on all types of low, medium or highly turbid muddy water.

Scientists have found that by adding only 50 mg of shelled drum stick tree seeds they could purify one litre of polluted water. The purified ‘Moringa’ when used as a coagulant was found to be non-toxic, biodegradable and environmentally friendly and it also did not alter the water’s chemical properties. Alum has the disadvantage that it significantly alters the pH and conductivity of water after the treatment.

The ‘Moringa’ treatment also produced four to five times less sludge due to coagulation which was less harmful when compared to the large volume of chemical sludge produced by alum coagulation. This property meant there was much less toxic sludge from ‘Moringa’ treatment to dispose off.

In 2000, scientists Muyibi and Evison found that by adding a suspension made of drumstick tree seeds to turbid water not only led to coagulation but after two hours of settling it reduced both turbidity and the hardness of the water by 60-70%. Drumstick or Moringa seeds also have a natural ‘buffering’ capacity and help reduce the alkalinity of the water by 30%. In short, turbid and dirty water can be easily purified using extracts of drumstick seeds.

Once again, in 2005, Swedish scientists who treated a water and salt mixture with extract of drum stick tree found that its coagulant protein remained active even after it was heated for five hours at 95°C. They confirmed that the Moringa coagulant protein had antibacterial effects, could cause flocculation or clumping together of foreign particles and the results of treatment of high turbidity samples were similar to water purified by addition of alum or aluminum sulphate.

Another team of scientists in 2005 found that extracts obtained by soaking intact drumstick tree seeds in water had both antibiotic and antioxidant properties and again the coagulation properties were similar to water samples treated with alum.

The widespread contamination of ground water with heavy metals like...
arsenic, cadmium, lead, copper, nickel, zinc, etc. has widely affected public health all over the country. The density of heavy metals (atomic number 22 to 92) is around five times that of water and in unbalanced quantities they are very poisonous to not only humans and animals but also plants. In 2004, a research team led by the author, conducted a UGC-sponsored study and found that drum stick tree seed extracts showed very good capacity not only for removing dyes but were also able to remove Calcium, Magnesium and Zinc from waste water.

In January 2006, scientists in Agra found that Shelled Moringa Oleifera Seeds (SMOS) could remove toxic metals like Cadmium from water bodies. In another 2007 study, DRDO scientists found that almost six million people in West Bengal risked exposure to arsenic compounds from contaminated ground water obtained from hand-pumped tube wells. Ironically, in 2006, a group of scientists had already developed a domestic and environment-friendly safe technology by using ‘Shelled Moringa Oleifera Seeds’ (SMOS) for removing poisonous arsenic from water bodies.

In 2007, a group of scientists subjected rats to arsenic poisoning. When they fed them ‘Moringa oleifera’ extracts, they found a reduction in the toxic effects and concentration of arsenic poison in the rats’ bodies. Again in 2007, another group of scientists found that they could remove Zinc from water by using pretreated drum stick tree extracts.

In 2008, Spanish scientists used a ‘Moringa oleifera’ seed extract to remove a common water pollutant, ‘Sodium lauryl sulphate’ commonly added to soaps and detergents. In June 2009, the same scientists used the ‘Moringa oleifera’ as a coagulant agent to remove 80% of a dye called ‘Carmin Indigo’ from wastewater released from dyestuff industries. Significantly, in 2008, another team of Spanish scientists succeeded in using ‘Moringa oleifera’ seed extract as a coagulant to remove up to 99% of several different types of dyes called ‘Azo dyes’ from waste water. Brazilian scientists in May 2009 found that ‘Moringa Oleifera’ seeds could also be used for treatment of dairy industry wastewater.

These discoveries could help proper pre-treatment of harmful effluents that contain large quantities of pollutants released by farms, industries, laboratories, hospitals, textile units and tanneries.

Incidentally, in September 2008, German veterinary scientists used ‘Moringa oleifera’ seed as an additive to normal food given to sheep and found it improved their digestion. They even recommended that standard levels of ‘Moringa’ extract be used as an additive to improve the growth rate of lambs. In 2009, Brazilian scientists found that Moringa Oleifera seed extracts could delay the growth and ultimately kill the larvae of the dangerous mosquito species Aedes aegypti that spreads malaria. So, these extracts can be used as animal food additive, for water purification and for destroying mosquito larvae!

**Economic Benefits**

Sadly, despite extensive scientific research since 1954 establishing that the versatile drumstick did have unique properties, our Corporations, Municipalities and Panchayats appear reluctant to use this inexpensive method to purify tap water or guarantee that the raw water ends up completely (100%) free of pathogenic germs. The water could still contain some pathogenic microorganisms which must be removed or destroyed by further membrane filtering, boiling or UV treatment. However, the pretreatment of water by this inexpensive method could help reduce the prevalence of water-borne diseases like cholera in impoverished rural and urban areas in Asia, Africa and southern America. Our rural population must be encouraged to increase the cultivation of ‘Moringa’ trees and to use its products for primary treatment of well, river or stored rain water. The additional benefits would be using the extracts to control mosquito larvae and stop the spread of mosquito-borne diseases like malaria, dengue or chikungunia. Further, the ‘Moringa’ leaves, branches, seeds, roots, etc. can be used as food for humans, as animal and poultry feed or be sold in bulk to local Ayurvedic companies to make medicinal products.

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