

Inspired by coffee rings, scientists discover low-cost method to detect toxic dyes in food

TIMES NEWS NETWORK

Bengaluru: A team of scientists at Raman Research Institute (RRI) has discovered a simple and effective way to detect toxic dyes such as Rhodamine B, by using the same everyday phenomenon that causes coffee stains on a table.

When a drop of coffee dries, it leaves a dark ring around the edges. This happens because as the liquid evaporates, tiny particles inside it move outward and settle along the rim. Scientists call this the “coffee-stain effect”.

MARVELS OF SCIENCE

The RRI team realised this effect could be used in the lab to detect harmful chemicals that are otherwise too small to measure.

In their study, the researchers focused on Rhodamine B, a bright pink fluorescent dye used in textiles and cosmetics but banned in food products because it can damage the skin, eyes and respiratory system. It also poses environmental risks as it can persist in water for a long time.

To detect the dye, the team mixed gold nanorods — microscopic rods only a few nanometres long — with water and placed a drop of this mixture on a clean silicon surface. As the drop evaporated, the nanorods were carried to the edge of the ring and formed a thin layer. When the concentration of nanorods was high, they packed tightly together, creating many “hot spots” where

IISc team boosts pesticide efficiency

TIMES NEWS NETWORK

Bengaluru: When farmers spray pesticides on crops, much of them never stick to the leaves. Because most plants have waxy and water-repellent surfaces, water droplets either roll away or bounce off. This not only reduces the effect of pesticides but also leads to soil and water contamination. Scientists at Indian Institute of Science (IISc) have now found a way to make pesticide sprays stick better using what they call “liquid marbles”.

Liquid marbles (LMs) are tiny water droplets covered by a thin layer of hydrophobic particles. This coating keeps the droplets from spreading or evaporating too quickly. The idea was first used in laboratories for chemical and biochemical experiments, but a team at IISc's Centre for Nano Science and Engineering (CeNSE) saw a new use for it in agriculture.

The group was led by Prosenjit light became strongly amplified.

When a laser was shone on these rings, even extremely tiny amounts of Rhodamine B produced a bright signal. The denser the ring, the stronger the signal. The researchers were able to detect the dye at concentrations as low as one part per trillion — comparable to a single drop of dye in a large swimming pool.



Sen, associate professor at CeNSE, and included Rutvik Lathia, a former PhD student who is now at Max Planck Institute for Polymer Research. “Around 50% of the pesticides are wasted because droplets bounce off leaves. Our method allows more of the pesticide to stay on the plant,” said Lathia.

The team made LMs by rolling small droplets of water over beds of hydrophobic particles. They first tried materials such as glass beads and Teflon, but those were harmful to plants. So, they turned to organic alternatives such as lycopodium, a

Liquid marbles are tiny water droplets covered by a thin layer of hydrophobic particles. This coating keeps the droplets from spreading or evaporating too quickly

plant-based powder, and zein, a protein found in corn. These biodegradable materials were found to be safe and more effective. The team tested LMs on rose leaves coated with Teflon to mimic natural waxy surfaces. High-speed imaging showed the marbles stuck well and lost more energy on impact.

The next step, Sen said, is to make the process cheaper and scalable. “We need to develop a mechanism to create large numbers of LMs during pesticide spraying.” The study was published in the *Journal of Colloid and Interface Science*.

“This technique is simple and inexpensive. The dried pattern itself concentrates the nanoparticles, allowing us to detect even minute quantities of toxins. Hand-held Raman spectrometers could easily be used for this,” Prof Ranjini Bandyopadhyay from the Soft Condensed Matter group at RRI, said.

According to the team, this method could help regulators monitor

banned dyes and other harmful chemicals in food, cosmetics and water, where such substances are often found in very small quantities that traditional equipment cannot detect. The study, which shows a phenomenon as common as a coffee ring, could inspire new tools for public health and environmental safety, has been published in a peer-reviewed journal.