Source : www.thehindu.com Date : 2024-01-20

ONE LITRE OF BOTTLED WATER CONTAINS AROUND ONE LAKH MICRO-NANO PLASTIC PARTICLES: STUDY

Relevant for: Developmental Issues | Topic: Health & Sanitation and related issues

January 20, 2024 06:47 pm | Updated 07:10 pm IST

Bottled water is displayed for sale at a store on January 10, 2024 in Austin, Texas. (Representational image) | Photo Credit: Brandon Bell/Getty Images via AFP

A litre of bottled water can contain more than one lakh particles of micro-nano plastics, with 90% of those being nanoplastics, a new study has revealed. Nanoplastics are minute in size, with dimensions ranging from 1 nanometre to 1 micrometre. The new findings are way more than the concentration of microplastics previously reported in bottled water.

The study, conducted by scientists at Columbia University in New York and published on January 8, 2024, profiled individual plastic particles with the intention to bridge the knowledge gap that exists in analysis of nanoplastics due to lack of effective techniques. Experts also believe that the study can be instrumental in providing information about plastic pollution at nano level.

Nanoplastics are difficult to analyse, mainly due to their size and plastic-identifying specificity of techniques. The experiment involved addressing these challenges using a custom hyperspectral stimulated Raman scattering (SRS) imaging platform. The platform can take multiple molecular images at different wavelengths to allow for a comprehensive understanding of the composition of the material under study.

SRS microscopy uses Raman Effect – the scattering of molecules depends on the medium it passes through.

The imaging platform was used with an automated plastic identification algorithm that provided detailed information about the chemical makeup at the single-particle level. Once the method was established to detect nanoplastics quickly and accurately, bottled water was used as a model system to study micro-nano plastics.

The investigation revealed the presence of approximately $2.4 \pm 1.3 \times 10^5$ micro-nano particles per litre of bottled water. The order of magnitude of the result reveals that microplastics are more abundantly present in bottled water than what was previously reported.

Traditional single-particle chemical imaging techniques like Fourier Transform Infrared Spectroscopy (FTIR) or Raman microscopy have lower instrumental resolution and detection

sensitivity. They are hence limited to chemical composition only at the microplastic level. On the other hand, particle-imaging techniques, like electron microscopy and atomic force microscopy, with nano-level sensitivity are not suited to differentiate compositions.

The tiny nanoparticles, which were previously unnoticeable using older imaging techniques, are the dominant ones in the composition, accounting for approximately 90% of the entire plastic population detected in the study. The remaining 10% were identified as microplastics, with a concentration of around 3×10^4 particles per litre, and most of them measuring under 2 micrometres.

The study also revealed the presence of particles in the sample that do not match any standards, indicating the complicated particle composition of bottled water. If we assume all detected organic particles originate from plastics, the concentration of micro-nano plastics will be even higher than estimated in this study. However, the presence of naturally occurring organic matter complicates the spectroscopy analysis and requires differentiation.

The possibility of heteroaggregates between nanoplastics or other natural organic matter is an already recognised potential challenge that may influence toxicological outcomes within biological systems.

The study confirmed the fragmentation of plastic beyond the micron level in real-life samples, despite nanoplastics being invisible or unidentified under conventional particle imaging techniques. It’s easy to overlook this nanoplastic population in mass quantification, the researchers said.

Counting the particles in the model system revealed a complex relationship between the composition and shapes of plastics in the system, providing valuable insights into nanoplastics, especially at a time when plastic pollution continues to be a global concern and research has shown that plastic continues to disintegrate even beyond the micron level, with the possibility of crossing biological barriers and entering biological systems like living beings. This makes the fragmented, nano-level plastic potentially toxic.