Dr. Azza Naija explaining to her research team.

Are Plastic Additives in Our Water a Hidden Danger?

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Qatar's National Vision focuses on protecting natural resources, preserving aquatic ecosystems, and promoting the efficient use of water resources. However, pollution remains a global challenge, with plastic waste contributing significantly to long-term pollution. More than 300 million tons of plastic are produced annually, with at least 14 million tons ending up in the oceans. Among the most concerning plastic pollutants are plasticizers—chemicals added to plastics to make them more flexible and durable. These substances are widespread in many products, including food packaging, medical devices, household dust, vinyl flooring, toys, and even drinking water. Their presence raises serious concerns about their harmful effects on human health, such as obesity, diabetes, asthma, hormonal imbalances, fertility problems, and the potential risk of cancer.

Dr. Azza Al-Naiji, Research Associate at the Biomedical Research Center at Qatar University, has focused her research on the field of environmental toxicology. She was awarded an Academic Research Grant (ARG) in its first cycle for a project on the environmental impact of plasticizers in water sources. Her master's and doctoral research was dedicated to assessing the effects of environmental pollution—particularly cadmium and mercury—on fish species. She currently leads a team of four research assistants and 12 students under various grants, including the Undergraduate Student Grant, all working in the field of environmental toxicology. Their work focuses on studying the effects of plasticizers on Zebrafish **(Figure 1)** and understanding their implications for human health and aquatic ecosystems.

Figure 1: Zebrafish

In Qatar, the supply of water relies primarily on seawater desalination; however, plasticizers can pass through filtration systems due to their small particle size. In addition, these pollutants can enter water sources

through industrial activities, wastewater discharge, and the degradation of plastic infrastructure.

To study their impact, the research team used zebrafish, an ideal biological model due to its high genetic similarity to humans **(Figure 2).** The study revealed the presence of plasticizers in treated wastewater at concentrations of up to 1.17 µg/L, and in tap water at concentrations of up to 1.03 µg/L—levels exceeding the safe limits for human consumption. Experiments showed that even low levels of plasticizers could cause cardiac deformities and blood flow disturbances in zebrafish embryos, indicating potential risks to human health. The team is currently expanding the research to explore the effects of these pollutants on brain development and neurological functions, which may have far-reaching implications for human health.

Figure 2: Experimental design for Zebrafish exposure to plasticizer-containing water.

The presence of plasticizers in water sources raises significant concerns regarding public health and environmental safety. Based on these alarming findings, researchers are collaborating with relevant stakeholders to improve water quality standards. The team also seeks to work with government bodies and policymakers to propose new guidelines that ensure effective monitoring and regulation of these harmful chemicals. It is essential for citizens to understand how their daily interactions with plastic products can contribute to exposure to these substances and what measures they can take to minimize the risks. Encouraging the use of alternative materials and enhancing waste management strategies can help reduce plastic pollution at its source. Through research, innovation, and collaboration, sustainable solutions can be achieved for a healthier future.

Addressing water pollution caused by plasticizers is a crucial step in protecting public health and preserving water resources in Qatar. This research serves as a call to collective action among scientists, policymakers, and the community to tackle one of the most pressing environmental issues. The deeper our understanding of the effects of plasticizers and the ways they enter the environment, the greater our ability to develop long-term solutions. Environmental toxicology is a field that directly impacts human health, and it is the responsibility of scientists to explore solutions that will safeguard both ecosystems and communities.

To address this issue, we are also developing advanced filtration membranes to more efficiently remove plasticizers from water. These membranes, known as “low-fouling membranes,” offer several advantages over conventional filters, as they are designed to trap plasticizer particles while allowing clean water to pass through, ensuring high efficiency and low energy consumption. Researchers are subjecting these membranes to extensive testing under various aquatic conditions to evaluate their long-term performance. Once optimized, these systems can be integrated into large-scale water treatment plants, improving drinking water quality in Qatar and around the world. Tackling plastic pollution requires a collective effort from scientists, policymakers, industries, and communities. Investments in research and sustainable technologies will contribute to the development of more efficient filtration methods, the manufacturing of safer plastic alternatives, and the enhancement of waste management policies. Countries that rely on desalination, such as Qatar, must take proactive steps to ensure the removal of emerging contaminants like plasticizers from water treatment processes.

In addition to research and development, the impact of this work extends to industrial applications and sustainable development. Through collaboration with institutions such as the Ministry of Municipality and Environment, Ashghal, and the private sector, the team aims to develop innovative solutions that align with Qatar’s environmental goals. The findings also contribute to scientific advancement through the publication of research in peer-reviewed journals and presentations at international conferences. By fostering interdisciplinary collaboration, the team hopes to bridge the gap between academic research and real-world applications, thereby enhancing water safety and protecting the environment.

Furthermore, the research project is committed to enhancing education and student engagement, with Qatar University placing great emphasis on preparing the next generation of researchers. This project provides opportunities for undergraduate and graduate students to participate in advanced research in environmental toxicology. Students from fields such as chemistry, biology, and engineering are involved in laboratory work, data analysis, and field studies, gaining hands-on experience in assessing water quality and developing filtration technologies. This multidisciplinary approach aims to strengthen Qatar’s research capacity and empower students to contribute to sustainable solutions for environmental challenges.