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# Drugged Wildlife: The Fate of Our Pharmaceuticals

Researchers report that drugs in wastewater may disrupt endocrine systems of aquatic animals

Up to 90 percent of a pharmaceutical can leave the body in its active form. That means that drugs we ingest every day—from caffeine to contraceptives—enter the environment via wastewater. Although wastewater undergoes microbial and chemical treatment, most plants are not equipped to remove pharmaceuticals.

Undergraduate researcher Melissa Kramer, under Dr. Satomi Kohno of the Medical University of South Carolina, is investigating the impact of hormone-like chemicals left behind after wastewater processing. By assessing the ability of treated wastewater to activate estrogen and progesterone receptors, Kramer will determine whether wastewater entering the Charleston harbor may affect the reproductive health of exposed aquatic animals, as well as humans who eat seafood from the harbor.

"We did detect activity at the estrogen and progesterone receptors, but only at the 100x concentration of effluent, and we still don't know what the actual compounds activating the receptors are and their characteristics," said Dr. Satomi Kohno, qualifying the results of the on-going study. "But the compounds are there, and if they bioaccumulate in some organisms, and if the organism is an oyster or a trout, we'll eat it."

Estrogen and progesterone receptor signaling determines sex cell development in fish and humans, as well as reproductive behavior in fish. These processes are therefore sensitive to hormones present in the environment.

A 2014 study by Dr. Mitchell Kostich, an Environmental Protection Agency (EPA) researcher, found at least one active pharmaceutical ingredient in each of 50 wastewater treatment plants tested across the U.S. These plants collectively produce about 6 billion gallons of treated wastewater per day that are released into oceans, rivers, and streams.

"Most people don't realize how we impact the harbor," said Allan Clum, Director of Environmental Resources at the Charleston Water System Plum Island facility. Although it is possible to remove pharmaceuticals from wastewater, the exorbitant cost of technology has prevented U.S. treatment plants from implementing the necessary changes, particularly because the effects of pharmaceutical contamination are currently poorly understood.

Kramer's research on pharmaceutical contamination is funded by the National Science Foundation (NSF), through the Research Experience for Undergraduates (REU) program at the College of Charleston. The goal of the program is to explore the resilience and response of marine organisms to environmental change.

For more information on NSF's REU Program at CofC's Grice Marine Laboratory see:
http://reu.cofc.edu/ and YouTube video:
https://www.youtube.com/watch?v=9silEToQ5yY

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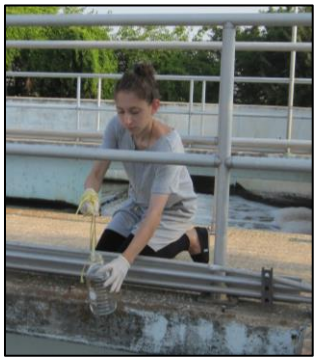

Kramer collects treated wastewater from Plum Island treatment plant just before the water enters Charleston harbor. *Photo by Satomi Kohno*