Subject: Bacteria making meds in wastewater outflows

http://www.environmentalhealthnews.org/ehs/news/2015/may/bacteria-making-meds-in-wastewater-outflows

May 13, 2015

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Environmental Health News

Wastewater treatment plants not only struggle removing pharmaceuticals, it seems some drugs actually increase after treatment.

When researchers tested wastewater before and after treatment at a Milwaukee-area treatment plant, they found that two drugs — the anti-epileptic carbamazepine and antibiotic ofloxacin — came out at higher concentrations than they went in. The study suggests the microbes that clean our water may also piece some pharmaceuticals back together.

Carbamazepine and ofloxacin on average increased by 80 percent and 120 percent, respectively, during the treatment process. Such drugs, and their metabolites (formed as part of the natural biochemical process of degrading and eliminating the compounds), get into the wastewater by people taking them and excreting them. Flushing drugs accounts for some of the levels too.

"Microbes seem to be making pharmaceuticals out of what used to be pharmaceuticals," said lead author Benjamin Blair, who spearheaded the work as a PhD. student at the University of Wisconsin-Milwaukee. Blair is now a postdoctoral fellow at the University of Colorado Denver.

Blair and colleagues found 48 out of 57 pharmaceuticals they were looking for at the South Shore Water Reclamation Facility in Oak Creek, Wisconsin, which serves the greater Milwaukee area.

The researchers have a clue as to how this might happen: microbes.

After removing the solids from incoming wastewater, treatment plants use microbes — tiny single-celled organisms — to decompose organic matter that comes in the sewage.

Blair's best guess is that people take the drugs, their body breaks them down into different metabolites that are excreted, and the microbes take these different parts of the drug and put them back together.

"It's a fascinating idea," Blair said.

Tanja Rauch-Williams, principal technologist at the environmental engineering company Carollo Engineers, said it was a strong study but cautioned that this doesn't mean wastewater treatment plants are acting as pharmaceutical factories.

"It's a large amount of pharmaceuticals that we [wastewater treatment plant researchers] look at, it's not a trend that the plants generate higher compound concentrations," she said. "It's very specific compounds."

"Microbes seem to be making pharmaceuticals out of what used to be pharmaceuticals."-*Benjamin Blair, University of Colorado-Denver*She said that this apparent piecing back together of metabolites into pharmaceuticals could, in principle, also happen in the environment after effluent discharge.

It's not the first time researchers have noticed this trend. Canadian researchers found carbamazepine more than doubled its initial medicinal load after treatment at a Peterborough, Ontario, plant.
"When others have found this, people thought it was due to things like sampling errors," Blair said. "But we found a clear upward trend over time."

What remains unclear is why only certain drugs would increase post-treatment. Blair and colleagues saw the trend in just two of the 48 pharmaceuticals found in their wastewater samples.

"We need to look for what the structural or metabolic commonality is in these compounds. And then we could possibly predict whether some would increase [after treatment]," Rauch-Willlaims said.

NASA

It seems that the microbes that clean our water at wastewater treatment plants piece some pharmaceuticals back together.

Even with the increases, the pharmaceuticals are at levels far below what could impact humans if they consume the water, she said. But the ubiquity of the drugs in wastewater is a concern for fish and other aquatic creatures.

Carbamazepine, used as an anti-epileptic drug, impacted the enzymes in gills, livers and muscles of common carp, according to a 2011 study. Such enzyme changes are indicative of tissue damage and impaired cells. The drug also has been linked to endocrine disruption and reproductive problems in zebrafish.

Rauch-Williams said the wastewater industry is getting more efficient at removing pharmaceuticals. "Things like advanced oxidation, UV disinfection coupled with peroxide, different membrane processes … these remove a large majority of these compounds," she said.

Blair said the drawback to many of the more effective treatments is expense. And there's no urgency for plants to upgrade because there aren't any U.S. regulations for pharmaceuticals in water, he added.

The U.S. Environmental Protection Agency evaluates substances that may be in drinking water by developing Contaminant Candidate Lists and periodically issuing a Regulatory Determination.

The EPA's latest drinking water contaminant candidate list — water pollutants not subject to regulations yet but that might render water unsafe — includes several pharmaceuticals that act on hormones.

For questions or feedback about this piece, contact Brian Bienkowski at bbienkowski@ehn.org.