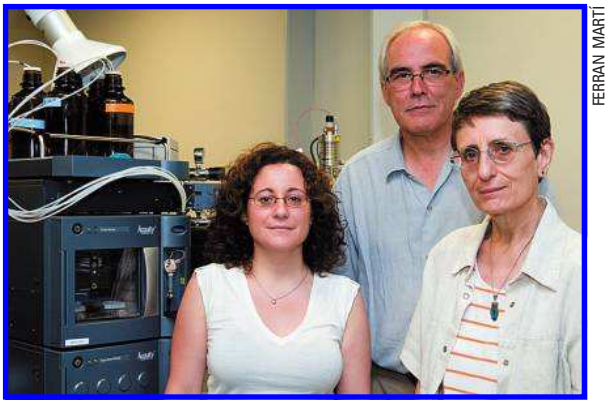
Cocaine from drains in Spain

Researchers have documented the flow of so-called drugs of abuse, such as cocaine, methamphetamine, and ecstasy, in rivers and streams from Venice, Italy, to Florence, Ore. However, new research published in *ES&T* (DOI 10.1021/es800768h) shows that conventional drinking-water treatment successfully removes these drugs and others considered to be more benign, such as caffeine and nicotine.

The researchers, from the University of Barcelona and the water corporation Grupo Agbar, tested water samples for a suite of illicit drugs that included PCP, LSD, cocaine, ecstasy, and methamphetamine, as well as several metabolites. They also looked for caffeine and nicotine; nicotine recently has shown promise as a biomarker of human activity (*Environ. Sci. Technol.* **2008**, DOI 10.1021/es800455q). Led by Francesc Ventura of Grupo Agbar, the team monitored the Llobregat, a highly polluted river in Spain, and several of its tributaries.

Drugs can be detected in the treated wastewater that is dumped into these water bodies by more than 55 treatment plants. To track the contamination, the team sampled river water at more than a dozen input sites during different seasons throughout a year. The researchers also took spot samples at the same time every day for a week in December at a treatment plant that provides drinking water for 1 million people. They followed up with a year of regular monitoring.

The researchers found that the river basin is basically flooded with caffeine and trace levels of nicotine. They also report that the rivers carried up to 15 grams (g) per day of cocaine and 195 g/day of benzoylecgonine, one of its metabolites. And although the team found two amphetamine-like drugs, ecstasy (MDMA: 3,4-methylenedioxy-*N*-methylamphetamine) and its analog MDA (3,4-methylenedioxyamphetamine), the researchers did not detect PCP and some of the other drugs on their list.



FERRAN MARTÍ

A team of researchers, including (left to right) chemists Maria Huerta, Ventura, and Teresa Galceran, examined the occurrence of illegal drugs in source waters and in treated drinking water in Spain.

But at the intake point of their test treatment plant, the scientists noted several trends: concentrations of nicotine and caffeine remained relatively steady year-round, with an increase in the summer and a slight dip in the fall. Regular spikes in the levels of cocaine and benzoylecgonine (60 and 770 nanograms per liter, respectively) came after weekends. Still, they found "notable loads" throughout the week, "indicating a relatively constant pattern of use," they wrote. But spikes in ecstasy and cocaine occurred around Christmas and New Year's, indicating a seasonal shift in drug use.

However, the drinking water was free from these drugs after undergoing a traditional sequence of treatment—aluminum-based coagulants and flocculants, sand filters, ozone, and finally chlorination to keep a residual level of chlorine in the distribution system that protects the drinking water during final delivery. "The combination of oxidants and sorbents can remove conventional contaminants, as well as emerging contaminants," including legal pharmaceuticals and illegal drugs, comments Stuart Krasner of the Metropolitan Water District of Southern California. Although the concentrations of these drugs in the environment are low, Krasner adds, long-term exposures to any small amount of a contaminant in drinking water raises concerns for human-health effects.

Other research shows that cocaine seems to be particularly intransigent. It has been found unchanged by natural processes in surface waters in Italy and the U.K. But the treatment at the Spanish water utility plant showed that "the [drinking-water treatment] process can practically remove all these compounds," says Ventura. "Some questions still remain: what happens when a more simple treatment is applied, and which potential disinfection byproducts are generated?" The results also show that "drugs of abuse are commonly found in the aquatic media at the same or higher concentration levels than other emerging contaminants (i.e., pharmaceuticals)," he adds.

—NAOMI LUBICK

10.1021/es8020606
Published on Web 08/06/2008