

Pharmaceuticals and personal care products in the environment, including illicit drugs residues, have become a public concern in recent years. Some of active illicit drugs or their metabolites may resist degradation in sewage treatment plants and enter the environment. The residues could affect the environment and the ecological system.

This study developed a method to rapidly extract a large volume of water using solid-phase extraction disks and utilized ultra-performance liquid chromatography (UPLC) combined with triple-quadrupole mass spectrometer and isotope-dilution techniques to determine several types of illicit drugs, including opiates, amphetamines, flunitrazepam, heroin and their metabolites in water. After sample pretreatment, chromatographic separation of the 18 drugs can be done in 7.5 minutes (including re-equilibrium), and the sensitivity as well as sample throughput were much improved.

This study compared the sensitivity and matrix effects in river water between electrospray ionization (ESI) and atmospheric pressure photoionization (APPI). The later was found to be more susceptible to matrix effects, especially for morphine-3 $\beta$ -D-glucuronide and ecgonine methyl ester. For this reason, ESI was selected to ionize analytes in sewage samples. This study also determined the residues of illicit drugs and their metabolites in influents and effluents of Taipei sewage

treatment plants (STPs) and evaluated the removal efficiency on these chemicals. The consumption of illicit drugs in Taipei was also estimated based on the population in the served area, based on flows of the STPs and measured levels of these chemicals in the influents.

In ESI mode, LOQs for illicit drugs in river water, influents and effluents were 0.054-8.76 ng/L, 0.14-23.8 ng/L and 0.22-15.2 ng/L, respectively. About half of the analytes were detected in both influents and effluents, including codeine, methamphetamine, MDMA, MDA, cocaine and its metabolite ecgonine methyl ester, which revealed that these chemicals could not be completely removed by STPs. The two STPs carried the equivalent of 2 to 52 g and 5 to 226 g of detected illicit drugs (including heroin, amphetamine, methamphetamine, MDMA and cocaine) per day. The consumption of methamphetamine was the highest among all the illicit drugs. At least two doses (100 mg per dose) were consumed per day per thousand people aged between 15 and 64 years.

Keywords: illicit drugs, UPLC/MS/MS, solid-phase extraction, waste water treatment, sewage, electrospray ionization, atmospheric pressure photoionization