K60 Analysis of the Cocaine Metabolite Benzoylecgonine in Wastewater

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After attending this presentation, attendees will gain insight on the utility of sewage epidemiology as a tool in forensic toxicology and the multiple applications of this methodology beyond the forensic science discipline, particularly in regard to toxicological investigations within law enforcement. The presentation will delineate the long-term benefits of this approach to society and law enforcement.

This presentation will impact the forensic science community by contributing an optimized method to forensic toxicology. Sewage epidemiology will reveal comprehensive information on the concentrations of illicit drugs in raw sewage that enables a more precise estimation of their illegal usage, and a relatively quick alternative to gain insight into the toxicological map of a given area. The presentation is geared toward generating interest in developing robust techniques for continuous data generation that can be used to make correlations with crime statistics and create sturdy monitoring tools.

Abuse of illicit drugs is a major problem in society and leads to high morbidity, mortality, and is responsible for many socio-economic problems. Estimates of cocaine consumption are currently obtained from crime statistics, population surveys, and consumer interviews; these estimation methods may not reflect the real extent of cocaine abuse. Another approach that has been used successfully in Europe is sewage epidemiology—a technique based on analysis of urinary biomarkers in sewage. This approach is based on analysis of a stable cocaine metabolite, Benzoylecgonine (BE) in waste water. In humans, cocaine is extensively metabolized to BE by chemical hydrolysis and Ecgonine Methyl Ester (EME) by enzymatic hydrolysis. BE is the major metabolite of cocaine; its presence in urine confirms cocaine abuse. In urine, cocaine can be detected up to 8 hr after use, while BE and EME can be identified for more than 96 hr after cocaine use.

Sewage epidemiology offers an adaptable, alternative method to consistently measure and monitor community drug use. Furthermore, the results from the study can be used to establish a framework for drug use monitoring. The goal of this study was to test the utility of sewage epidemiology in monitoring cocaine metabolite BE in waste water. Influent to the Lubbock (TX) Water Reclamation Plant (LWRP) was tested twice a week to assess weekly variations in cocaine consumption over a five-month period (February 2010 – June 2010). BE was extracted from influent wastewater samples using solid phase extraction and analyzed using Gas Chromatography/Mass Spectrometry (GC/MS). Filtered 500ml influent waste water samples were spiked with deuterated internal standard (BE-d_3) and extracted using Oasis® MCX 60mg SPE cartridges. To determine BE and BE-d_3 in sample extracts using GC/MS, the extracts were first derivitized using N-Methyl-N-(trimethylsilyl)trifluoroacetamide (MSTFA) to enhance volatility forming the Trimethylsilyl (TMS) derivative of BE or BE-d3. GC/MS analyses was performed using a DB-5MS column for separation and the Mass Selective Detector (MSD) was set to operate under selected ion monitoring mode targeting ion masses of 82, 240, and 361 for BE and 243 and 364 for BE-d_3.

The concentrations of BE derived from the analysis were used to calculate cocaine equivalents deposited in the sewer system through excretion by users. The cocaine equivalents and wastewater daily volumes and flow rates were used to estimate cocaine use by the population. The average daily consumption of cocaine during the study period was estimated at 1,152 ± 147g. Higher cocaine consumption was observed on weekends compared to weekdays. The present study showed that sewage epidemiology is a useful tool to detect BE and subsequently estimate cocaine consumption. The method described is an efficient tool for investigating temporal variations (daily, weekly, and seasonal) at a local level. In addition, this method, along with the ability to sample wastewater at the neighborhood level, could provide a valuable forensic tool for law enforcement.

Cocaine, Sewage-Epidemiology, Toxicological Map

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