K56 A One-Year Study of Cocaine and Heroin in Waste Water Plants in Florence, Italy

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The goal of this presentation is to present data on a one-year study of cocaine and herion concentrations in waste water plants in Florence, Italy.

This study will impact the forensic science community by proving once again the potential of the analysis of drugs and metabolites in waste water as a tool in monitoring drug abuse and, especially, in the identification of trends in consumption habits.

Determination of drugs and metabolites in wastewater collecting plants (WWP) is a newly and efficiently developed strategy in the assessment of substance use and abuse in several different countries. In particular, in the last years, determination of cocaine and other drugs in wastewater was proposed to estimate *per capita* consumption with better reliability than traditional markers (as epidemiological studies, drug confiscations, crime statistics). Although an inter-laboratory validation of methods of analysis and data elaboration (especially in relating water concentration with population) is needed before this can be used as a widespread monitoring tool, the analysis of wastewater from a specific collection site by a validated method over a certain period of time can be helpful in the identification of trends in drugs use.

The amount of cocaine was determined (measured as the sum of cocaine and benzoylecgonine) and heroin (measured as morphine) over one year (July 2006-June2007) in wastewater of the City of Florence. Analytical results were used to evaluate a trend in the use of these drugs and to speculate on the impact of tourist flow on cocaine/heroin consumption in the city of Florence.

Wastewater was collected every month at two different WWPs located on opposite sides of the Arno River before any treatment. Three liters of water were analyzed by solid phase extraction (on Bond Elute LRC Certify, Varian Inc. Lake Forest, CA, according to the manufacturer's instructions for basic drugs with minor modifications), followed by N-Methyl-N- trimethylsilyltrifluoroacetamide derivatization and gas chromatography-mass spectrometry (GC-MS). Cocaine (COC), benzoylecgonine (BE) and morphine (MOR) were identified in selected ion monitoring mode (ions 82, 182, 272, 303 for COC, 82, 240, 346, 361 for BE, and 324, 401, 414, 429 for MOR). Four-point calibration curves were prepared (from 25 to 200 ng/L for COC and BE and from 22 to 212 ng/L for MOR) and accuracy and precision were calculated by repeatedly injecting three quality control (QC) points (25, 50, 150 ng/L for COC and BE, 22, 37, 153 for MOR). The analytical method was found to be linear for all substances in the range of interest (COC: slope: 44.72 ± 2.20, intercept: 2.39 ± 5.63, R^2: 0.9920 ± 0.008; BE: slope: 320.96 ± 39.36, intercept: 17.55, R^2: 0.9853 ± 0.016; MOR: slope: 515.54 ± 28.93, intercept: 3.8 ±7.49, R^2: 0.9975 ± 0.002). For the three substances, accuracy and precision results were better than 18.4% bias and 14.2% relative standard deviation at the lower QC and better than 10.2% bias and 14.8% relative standard deviation at low and high QC.

Cocaine (calculated as COC + BE equivalents) was assessed to be used in the city of Florence in the range between 42.84 and 82.54 g/day (mean: 59.05 g/day, median: 55.55 g/day), with the highest amounts in August (82.54 g/day), December (78.24 g/day), and March (78.79 g/day). The lowest quantities were retrieved in September (42.84 g/day), October (43.70 g/day), and January (44.69 g/day). Heroin (calculated as morphine equivalents) use was estimated to be used between 2.92 and 17.17 g/day (mean: 9.80, median: 10.56 g/day). The highest amounts were observed in January, March, and April (14.78, 15.58, and 17.17 g/day, respectively) and the lowest in July, September, and October (2.92, 3.93, and 3.84 g/day, respectively). The analysis of cocaine and heroin in surface water over a 12-month period is, to our knowledge, unprecedented and, on the basis of these preliminary data, it is possible to: (i) recognize an increment in the use of heroin in the period taken into consideration (with an average of 4.7 g/day in the first trimester and 12.8 in the last one), (ii) speculate that cocaine use seems higher when the tourist flow is more intense (August and December, in particular), and (iii) assume that heroin does not appear to be influenced in this way (highest amount from January to April).

This study proves once again the potential of the analysis of drugs and metabolites in wastewater as a tool in monitoring drug abuse and, especially, in the identification of trends in consumption habits. Finally, the project is still ongoing and is being extended toward more substances and metabolites.

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