

## Methamphetamine pyrolysis byproducts in wastewater – A way of distinguishing administration routes?

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Consumption of methamphetamine (MA) in Australia is a widespread phenomenon, yet, depending on the indicator considered, contrasting figures are obtained regarding its magnitude. Wastewater analyses show a dramatic increase in its use<sup>1,2</sup>, whilst household surveys suggest constant prevalence rates<sup>3</sup>. Nonetheless, forensic and survey data indicate that consumption of high purity crystalline MA is increasing, which raises concerns due to its consumption via inhalation<sup>4</sup>, a more problematic administration route compared to other non-injecting routes<sup>5,6</sup>.

Smoking of MA generates various pyrolysis byproducts<sup>7</sup>. N,N-dimethylamphetamine (DMA), in particular, has been found in the urine of users<sup>8</sup>, as well as in combustion residues recovered from smoking devices<sup>9</sup>. Whilst DMA can be found as an impurity in MA seizures, forensic analyses indicate that its abundance relative to MA is low (approximately 0.05%). Hence, DMA and DMA/MA ratios could be used as markers of MA smoking.

This work focused on the analysis of MA pyrolysis byproducts in wastewater samples and on the detection of potential geographical and temporal differences in consumption habits in Australian communities. Solid-phase extraction (SPE) followed by liquid chromatography quadrupole time-of-flight mass spectrometry (LC-QTOF-MS) were used for quantitative analysis and suspect screening.

DMA was detected in most samples and concentrations ranged from <LOQ (i.e., 0.5 ng/L) to 39 ng/L. Significant differences (p-value <  $\alpha = 0.05$ ) in DMA/MA ratios were observed between locations. Overall, DMA/MA ratios and population normalised MA loads were positively correlated (Pearson's correlation=0.7,  $p < 0.0001$ ). Yet, some locations showed lower DMA/MA ratios than expected, suggesting that high MA consumption was not always associated with high prevalence of smoking. Temporal data for one location showed a decrease in DMA/MA ratios in the period 2014-2016 compared to 2011-2013. At the same time, a steep increase in MA loads in wastewater was observed. These could be due to an increase in MA purity, hence containing fewer synthesis byproducts, including DMA.

Although the interpretation of DMA/MA ratios requires information about the purity of MA seizures, which can be obtained from forensic laboratories, it can be used to identify areas with potentially higher prevalence of problematic use (i.e., smoking) and monitor the evolution over time.

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