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Project	The molecular basis of chemical hair evidence
Fields of interest	Hair analysis, ambient mass spectrometry
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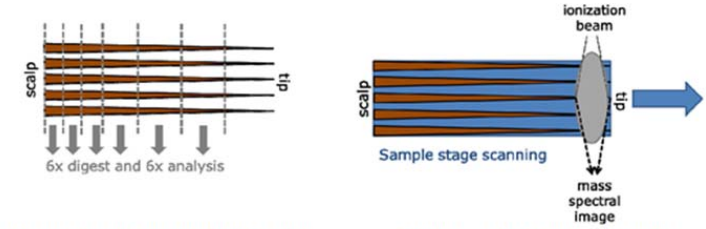
Introduction

Many chemical compounds – including drugs (of abuse), toxicants and doping substances – accumulate in hair. Hair analysis is of particular forensic interest since (I) it provides a prolonged detectability versus bio analysis in body fluids, in some cases even up to several months, (II) non-invasive sampling is easily performed, and (III) analysis of longitudinal hair segments can provide a retrospective estimate of the time of drug intake based on the average growth rate of hair. But forensic hair evidence is often challenged by the external contamination hypothesis, which cannot be fully ruled out on the basis of current empirical washing and decontamination practices. Therefore, a firm scientific basis for the interpretation of the presence of compounds in or on hair, due to drug intake, or due to external contamination, is urgently needed.

In conventional (segmented) hair analysis, washed hairs or segments thereof, are individually analysed by liquid or gas chromatography coupled to tandem mass spectrometry (GC-MS/MS, LC-MS/MS), which is rather laborious. In an ideal situation the hair surface would be scanned by a mass spectrometer acting like a 'chemical microscope' and providing in one run an accurate retrospective timeline assessment of drug intake plus valuable information about external contamination related chemical patterns.

In addition, mass spectrometric monitoring of specific chemical profiles on the hair surface, such as drug metabolites and intact drug adducts, would support substantial evidence for either the treatment- or the external contamination hypothesis.



a) Conventional segmented hair analysis
Typical segment length: 5-10 mm

Multiple analysis: laborious and time-consuming (day(s))
Destructive due to hair digestion

Sensitive (provided enough hair material is sampled)

b) Proposed hair surface scanning
Spatial resolution: more accurate retrospective timeline assessment
Short analysis time (minutes)

Not necessarily destructive, might still allow conventional analysis
Sensitivity challenge

Goal

The aim of this project is to study the accumulation, stability and decontamination of drugs in hair at the molecular level using state-of-the-art surface analysis and molecular imaging techniques (DART and MALDI). Moreover, chemical profiling of hair will be performed to find molecular discriminants such as intact (covalent) drug adducts that can support substantial evidence for drug intake and exclude the contamination hypothesis.

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References

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