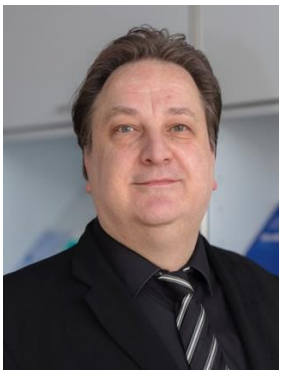
Mass Spectrometry in Forensics

Thomas Kraemer

Zurich Institute of Forensic Medicine, Dept. of Forensic Pharmacology and Toxicology, University of Zurich, Zurich, Switzerland. Email: thomas.kraemer@irm.uzh.ch



Thomas Kraemer is Professor for Forensic Pharmacology and Toxicology at the Medical Faculty of the University of Zurich. He is Deputy Director of the Zurich Institute of Forensic Medicine and head of the Department of Forensic Pharmacology and Toxicology (FPT). He has its main research focus on development and validation of new bioanalytical methods (e.g. new screening strategies using novel MSall techniques e.g. SWATH acquisition); high-resolution MS; MALDI-MSI), metabolism studies, interaction studies, postmortem toxicology, elucidation of incorporation mechanisms of xenobiotics in alternative matrices such as hair or nails and use of metabolomics and proteomics in forensics.

Abstract:

According to The American Board of Forensic Toxicology (ABFT), forensic pharmacology and toxicology encompasses the measurement of alcohol, drugs of abuse, prescription drugs and other substances in biological specimens and interpretation of such results in a medico-legal context. While Sherlock Holmes did not need more than a magnifying glass to solve cases, highly sophisticated mass spectrometric equipment is a prerequisite for successful forensic casework in the modern forensic lab. Confirmation of immunoassay results is routinely done by simple hyphenated MS techniques. However, more sophisticated MS techniques are needed for the very specific problems in forensic routine which are unknown to the normal user of mass spectrometry: Postmortem samples which can be anything from fresh to severely putrefied can cause surprising matrix effects. Sometimes only alternative matrices are available (tissues, organs, hair, nails, oral fluid, respiratory air). In the last years, hundreds of new psychoactive substances (NPS) have entered the market, for which reference standards are rarely available. Mass spectrometry has been used to encounter all these problems. Postmortem tissue samples are investigated by MALDI-MS imaging (MALDI MSI) techniques using multiple reaction monitoring mode for screening and MS/MS or MS^3 for confirmation. Consumption behavior of illegal drugs can be monitored in single hair using MALDI MSI or even TOF SIMS. Intake of drugs or medicaments can be detected even in exhaled air employing the most sensitive LC-MS/MS equipment. High resolution mass spectrometry allows for identification of new drugs. Finally, simultaneous QUAL/QUAN analysis using liquid chromatography high resolution MS and employing new Data Independent Acquisition (DIA) approaches (MS/MSALL with SWATH Acquisition) will make forensic toxicology fit for future. Finally, combination of LC-MS/MS and GC-MS/MS methods will open the world of metabolomics and proteomics for forensic purposes.