B132 Method Development and Application of High Resolution ICP-MS (HR-ICP-MS) and Laser Ablation (LA-HR-ICP-MS) for Elemental Analysis of Bone, Teeth, Nail, and Hair Samples

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The goal of this presentation is to show the method development of the elemental analysis and its application to real samples of bone, teeth, hair and nails using solution based and laser ablation with HR-ICP-MS. This presentation will impact the forensic science community by demonstrating the development and application of robust analytical methods for the detection and quantification of trace elemental analysis in bone, hair, teeth and nail matrices will lead to a better understanding of the potential utility of these measurements in forensic chemical analyses.

Biological matrices such as bone, teeth, hair, and nails have captured the attention of the forensic scientist during the last decades, since they are commonly found in crime scenes and/or massive burials. The elemental composition of such matrices can provide key information of environmental exposure at working places, heavy metal poisoning, discrimination between individuals and for provenance purposes. It is possible to follow up elements naturally found in the body and their concentrations by analyzing hair,[1] nails,[2] and bones or teeth.[3, 4] Recent applications of elemental composition of such matrices to human authentication[5] have resulted in the resolution of crimes. Some trace elements in bones (such as strontium) can act as geographical markers and can suggest the origin of a person either in the early ages or in the last years of his life.[6-8] Therefore biological matrices play an important role in the forensic analysis of a crime scene. The development and application of robust analytical methods for the detection and quantification of trace elemental analysis will lead to a better understanding of the potential utility of these measurements in forensic chemical analyses.

Elemental analysis of glass and paint by ICP-MS and LA-ICP-MS has shown to provide a very high degree of discrimination between different sources of manufacturing of these materials. There has also been an interest in the application of elemental analysis by these sensitive methods to the analysis of biological matrices such as bones, hair, nail, and teeth. Among the instruments used to study these biological materials are Neutron Activation Analysis (NAA), Atomic Absorption Spectrometry (AAS), X-Ray Fluorescence (XRF), Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP- AES), Laser Induced Breakdown Spectroscopy (LIBS), and Inductively Coupled Plasma-Mass Spectrometry (ICP-MS). For the analysis of biological matrices, most of these techniques require consideration of: (1) high complexity of the matrices, (2) resolution of spectral interferences, (3) a wide concentration range of elements (ng/g – %wt), (4) cumbersome sample preparation procedures, and (5) contamination of these samples. Inductively Coupled Plasma Mass Spectrometry (ICP- MS) is one of the preferred techniques for elemental analysis since it can provide excellent sensitivity, accuracy and precision of the analysis. The use of a sector field High Resolution Inductively Coupled Plasma Mass Spectrometry (HR-ICP-MS) system offers the resolution of polyatomic interferences improving the detection of trace elements in complex matrices such as bone, teeth, hair, and nails in addition to improving the detection limits over a quadrupole based ICP-MS device. By coupling a laser ablation (LA) system for solid sampling, the sample preparation steps and the destruction of the sample are reduced significantly. The analytical method developed for the elemental analysis of biological matrices using HR-ICP-MS and LA-HR-ICP-MS will be presented along with a comparison of the analytical data retrieved from solution and LA-based analyses using standard reference materials (SRMs) and actual samples.

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