E37 Elemental Composition of Tattoo Inks as an Identification Tool

Trevor E. Curtis, BS, Michigan State University, 578 S Shaw Lane, Rm 319, East Lansing, MI 48824; John P. Buchweitz, PhD, Michigan State University, 4125 Beaumont Road, Lansing, MI 48910; and Ruth Waddell Smith, PhD, Michigan State University, School of Criminal Justice, 560 Baker Hall, East Lansing, MI 48824*

After attending this presentation, attendees will understand the elemental composition of tattoo inks, the ability to use these compositions to differentiate tattoo inks from one another, and the development of a tattoo ink database containing their compositions and its potential uses.

This presentation will impact the forensic science community by providing further information on the composition of common tattoo inks. As these inks are not regulated in the United States, such information is not widely available although it has the potential to be used in the identification of decomposed or otherwise severely damaged human remains.

The art of tattooing has been practiced for thousands of years and has been used for human identification purposes for centuries. Tattoos have been used to mark slaves, brand criminals, and to show hierarchy in tribal populations. Currently, tattoos are viewed as an art form. Because of this, their popularity has grown drastically in recent years to the point where an estimated one-tenth of the world's population and one-quarter of the United States population brandishes this identifying mark.

Tattoo ink is injected into the dermis, to a depth below that where most damage from cuts and even second-degree burns occur. This gives tattoos a degree of permanence as they are relatively unaffected by superficial changes to the skin. Accordingly, tattoos have the potential to be used to narrow down the possible identifications of severely damaged human remains. For example, the National Missing and Unidentified Persons System currently has 11,429 open missing person cases. The possible identifications drops to 100 people when the system is searched for persons with red tattoos, narrowing the search; however, when severely damaged human remains are found, any tattoos are unlikely to be visible. The elemental composition of tattoo ink has the potential to be used to determine if a tattoo is present and the color of the ink. This information could then be used to further support identification efforts.

The overall objective of this research is to determine the utility of tattoo ink for the use of body identification in various stages of decomposition; however, as the composition of tattoo inks is unregulated in the United States, the identity of the elements present is relatively unknown. Hence, the first step in this research is to determine the elemental composition of common tattoo inks.

To accomplish this, a set of common tattoo inks were purchased and microwave-digested in hydrogen peroxide and nitric acid. The acid digests were further diluted and analyzed by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS). Based on previous reports, nine elements including copper, titanium, and barium were selected for analysis in this initial study. The instrument was calibrated for these elements and analytical figures of merit, including linear range and limit of quantitation, were determined. The inks were then analyzed, quantifying the nine elements present in each ink.

Initial analysis of tattoo inks indicates discernable elemental composition differences between inks of different colors. For example, blue and green inks contain copper at concentrations up to 12.4mg per gram of ink while other colors tested tend to contain less than 0.5mg copper per gram of ink. Likewise, some yellow inks can be distinguished based on high barium concentrations, up to 5.5mg/g compared to 0.005mg/g or less in other inks. This presentation will further discuss the elemental concentrations of tattoo inks and introduce the development of a searchable database containing element compositions of the tattoo inks analyzed thus far.

Tattoo Ink, Element Composition, ICP-MS

*Presenting Author