E42 Preservation of Hair Stable Isotope Signatures During Freezing

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After attending this presentation, attendees will understand the suitability of law enforcement preservation protocols for hair Stable Isotope Analysis (SIA) in a range of typical casework samples.

This study will impact the forensic science community by scientifically validating current law enforcement practice. It will also serve to increase knowledge of the benefits of SIA to the law enforcement community.

Stable isotopes are an important tool in establishing the provenience of unknown human remains.[1,2] Studies demonstrate oxygen, hydrogen, carbon, and nitrogen isotopes in hair define an individual's travel and dietary history over months to years.[3,4] Studies validating SIA for provenience primarily analyze samples from living individuals or discarded salon waste, analyzed soon after collection and stored at room temperature. Although individual ancestry and cosmetic treatments of hair can influence measured drug concentrations and damage from Ultraviolet (UV) radiation, these factors have not been systematically studied in regard to stable isotopes. In contrast to validation studies, typical forensic case samples may include degraded material exposed for extended periods to dirt, rain, insect activity, and decomposition fluids.

Standard law enforcement collection techniques typically freeze evidentiary hair samples for DNA processing. Because samples may be frozen in contact with water or decompositional fluid, ice crystals may form during storage, with the potential both to physically damage the proteins of hair and allow isotopic exchange between samples and isotopically distinct local humidity. Although successful case reports suggest freezing is an appropriate storage method, a more systematic validation is needed.

Salon samples (n=14) were collected, including hair treated with relaxers and coloring agents. To evaluate preservation of degraded material, hair mats from the University of Tennessee's Anthropology Research Facility (n=2) and Texas State University at San Marcos' Forensic Anthropology Research Facility (n=4) were also analyzed, from decedants exposed on the ground surface outdoors for up to eight months. Each sample was separated into five aliquots: (1) control samples; (2) plastic clamshell for three weeks; 3) plastic clamshell for three months; (4) butcher paper for three weeks; and, (5) butcher paper for three months at -20°C. Each sample was packaged and sealed in accordance with the Mesa Police Department's Evidence Section guidelines.

To evaluate longer-term storage, paired samples from ten individuals at the University of Tennessee's Anthropology Research Facility were also analyzed. These were samples collected upon donor intake, with aliquots being stored at both room temperature and frozen. Periods of preservation ranged from 9 months to 4.1 years.

All samples were cleaned by standard methods and analyzed for carbon, nitrogen, oxygen and hydrogen isotopes by Isotope Ratio Mass Spectrometry (IRMS). There were no significant trends in $\delta^{18}O$, δD, $\delta^{13}C$, $\delta^{15}N$, or weight percent O, H, C or N in any of the samples for either sample storage period, or utilizing either packaging material. Freezing hair samples in typical law enforcement packaging is appropriate for forensic case work in stable isotopes.

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