E55 Sex and Race Determination Based on Attenuated Total Reflection/Fourier Transform Infrared (ATR/FTIR) Spectroscopy of a Bloodstain

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Learning Overview: After attending this presentation, attendees will gain knowledge about: (1) the limitations of current methods for bloodstain analysis during forensic investigation; (2) the importance of human phenotype profiling for forensic purposes; (3) the significance of a non-destructive method for examination of trace evidence at a crime scene; and (4) the advantages of FTIR spectroscopy in forensic investigation. The goal of this presentation is to disseminate results of FTIR spectroscopy for bloodstain examination as well as the results of chemometrics for distinguishing between human sexes and races.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by disseminating results of the non-destructive and rapid human sex and race determination from a bloodstain at a crime scene immediately after discovering a crime scene.

Human phenotype profiling is one of the most important analyses during a forensic investigation. It can play a crucial role in the early stages of investigation. All current methods of phenotype profiling based on the analysis of body fluid traces are destructive to the sample and, most importantly, need to be performed in a lab and not at a crime scene.

In this study, ATR/FTIR spectroscopy was evaluated as a potentially non-destructive, rapid, and *in situ* method for discriminating sex and race based on the analysis of human bloodstains. It is known from the literature that the biochemical composition of blood changes with donor sex and race. ATR/FTIR spectra were acquired from dry bloodstains, and an advanced statistics methodology was utilized to enhance the differentiation capability of the method. Specifically, Partial Least Squares Discriminant Analysis (PLSDA) was employed to create models for differentiating Caucasian (CA), African American (AA), and Hispanic (HI) donors according to their sex and race. This approach was evaluated by subject-wise Leave-One-Out Cross-Validation (LOOCV), resulting in a greater than 90% correct classification. In addition, the main models were validated externally with four hold-out samples, which were not used for the training data set. The validation with hold-out samples resulted in 100% accuracy for both sex and race predictions at the donor level.

Overall, this proof-of-concept study demonstrated the great potential of ATR/FTIR spectroscopy and chemometrics for phenotype profiling for forensic purposes based on dry bloodstains. Translating this technology to a portable instrument would provide an excellent opportunity for conducting human phenotype profiling immediately after the crime scene is discovered.

Bloodstains, Phenotype Profiling, Nondestructive Analysis

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