B8 Analysis of Attenuated Total Reflectance/Fourier Transform Infrared (ATR/FTIR) Spectra to Differentiate Menstrual and Venous Blood on Various Substrates

Alicia Quinn, BS, 120 Stoney Meadow Lane, Madison Township, PA 18444; and Kelly M. Elkins, PhD*, Towson University, Chem Dept & Forensic Science Program, 8000 York Road, Towson, MD 21252*

After attending this presentation, attendees will better understand ATR/FTIR spectroscopy and how this method can be used to analyze spectra for body fluid samples on various substrates and differentiate venous and menstrual blood following statistical analysis.

This presentation will impact the forensic science community by suggesting a rapid, non-destructive method for differentiating body fluid samples, including venous and menstrual blood, on various substrates that can provide significant discriminatory information for forensic comparisons.

Body fluids are often encountered at crime scenes, especially those in which sexual and violent crimes have been committed. An alternate light source is often used to locate the presence of body fluids but is not used to identify them. Chemical methods are typically employed to tentatively identify the presence of body fluids including blood, semen, saliva, urine, and fecal matter. A drawback of using chemical methods is that they may dilute the sample, cause degradation, or interfere with DNA typing. ATR/FTIR spectroscopy has been suggested as a method that can be used to identify and differentiate body fluids in simulated forensic samples; however, only neat samples and samples on white paper and white cotton substrates were tested.

This study evaluated the entire ATR/FTIR spectrum (including the amide banding and fingerprint regions) for the body fluid samples on several substrates including colored cotton, polyester, nylon, wood, and glass. Blood, semen, and breast milk standard samples were purchased from Lee™ Biosolutions. Saliva and menstrual blood samples were obtained from healthy donors in accordance with Towson University Institutional Review Board (TU IRB) approval. A Thermo Fisher Scientific Nicolet™ iS™10 spectrometer with a Smart iTR™ ATR attachment and equipped with the Omnic™ software version 32 was used to collect all spectra. ATR/FTIR absorbance spectra (128 scans, 4,000 to 400cm-1 spectral range, 1.929cm-1 spectral resolution) were recorded using the ATR diamond crystal in ambient temperature with air as a background. A standardized volume of 20µL of each type of body fluid was deposited onto parafilm and dried at room temperature. The residue layer was applied directly to the cleaned diamond crystal surface. Separately, the neat body fluid samples were pipetted (20µL each) onto five different substrates. Reference spectra were recorded of each substrate and subtracted to identify contribution from the body fluid. Three replicates of each fluid were performed. The average signal was averaged over all scans and the data was saved as a .csv text file for import into Microsoft® Excel® for spectral analysis. Statistics were used in order to differentiate the body fluids from one another by looking at the presence or absence of a particular wavenumber (cm-1) as neat samples and on the surfaces. The statistical technique emphasizes the variations and draws out strong patterns in the dataset. Variations of the body fluid spectra provide significant discriminatory power and provide support for ATR/FTIR to be investigated further as a method that could be employed at the crime scene.

ATR/FTIR, Venous Blood, Menstrual Blood