## H139 Postmortem Interval Estimation Using ATR-FTIR and Raman Spectroscopy

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After attending this presentation, attendees will understand some of the techniques currently used to estimate the Postmortem Interval (PMI), a new method of estimating PMI in advanced stages of decomposition with spectroscopy, and the prospects of this research for the future.

This presentation will impact the forensic science community by providing an objective, reliable, and quick method of determining the time since death, which aids in identifying human remains, and resolving other aspects surrounding the death of the individual.

Estimating PMI is accomplished in a variety of ways, including scoring visual characteristics of decomposition, assessing characteristics of the environment in which a corpse is discovered, and analyzing the chemical components of soft tissues. As a body decomposes, the methods available to estimate PMI dwindle and become less accurate. Vibrational spectroscopy offers a simple, objective alternative to estimate PMI throughout the course of decomposition.

Vibrational spectroscopy includes a group of analytical techniques which identify the molecular components of a substance by passing light through the sample and measuring the energy change in the vibrations of chemical bonds as the bonds are distorted by the light energy. Raman and Attenuated Total Reflectance Fourier Transform Infrared (ATR-FTIR) spectroscopy are rapid, non-destructive techniques that yield results in minutes with minimal sample preparation.[1] Previous studies have successfully utilized ATR-FTIR spectroscopy to determine PMI from the kidney tissue of rats.[2] These results suggest that spectroscopic techniques may be able to estimate PMI of fluid samples after the body has reached an advanced state of decomposition and soft tissues no longer retain their integrity.

For this study, twelve domestic piglets, *Sus scrofa*, with a mean weight of 6.74kg were placed in plastic trays and allowed to decompose. Six pigs were placed in the shade and exposed to the environment; six pigs were placed indoors with an electric radiator ensuring an elevated temperature. In both experimental set-ups, insects had access to the carcasses, although access was delayed by approximately 15 ADD in the indoor group. Data loggers in the trays next to each pig recorded the temperature every hour. Fluid and tissue were sampled approximately every 20 Accumulated Degree Days (ADD) for 21 days, at which time the bodies were mostly skeletonized (mean Total Body Score = 30.25). All samples were frozen and then thawed prior to spectroscopic analysis. Samples were analyzed with both Raman and ATR-FTIR spectroscopy from 4000 – 400nm. Fluid was placed directly onto a diamond crystal and allowed to dry prior to ATR-FTIR analysis. Fluid for Raman analysis was placed onto CaF slides and allowed to dry before analysis with a 532nm laser.

The spectra obtained from the ATR-FTIR and Raman analyses were subjected to principle component analysis. Preliminary results indicate that the first three components can be used to classify samples based on ADD up to skeletonization where the fluid was available for collection in the plastic trays. The first three components explain up to 94% of the variance. This provides promising continuum of change from which a method to pinpoint PMI can be derived from the principle components.

Therefore, spectroscopy is a valuable tool in estimating the PMI of corpses from fresh to skeletonized in a variety of environmental conditions with available fluid. The results are objective and are available in minutes. As this technology advances and becomes more portable, investigators may be able to receive an estimate of the PMI while in the field at the initial visit, which may speed investigations and require fewer resources to solve each case.

**References:**

1. Vankeirsbilck T, Vercauteren A, Baeyens W, Van der Weken G, Verpoort F, Vergote G, Remon JP. Applications of raman spectroscopy in pharmaceutical analysis. Trac-Trend Anal Chem 2002;21(12):869-877.
2. Huang P, Ke Y, Lu Q, Xin B, Fan S, Yang, G, Qang Z. Analysis of post-mortem metabolic changes in rat kidney cortex using Fourier transform infrared spectroscopy. Spectroscopy 2008;22;21-31.

**Postmortem Interval, Raman Spectroscopy, FTIR Spectroscopy**

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