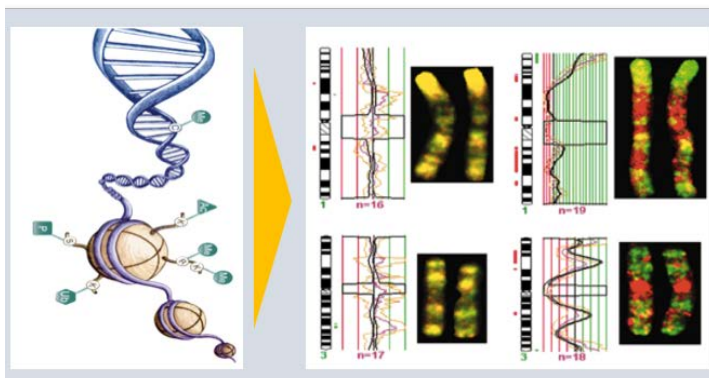




SUCCESS STORY

NIJ and Florida International University:

Forensic Epigenetics – Markers for the Identification of Body Fluids



“Our laboratory is excited about DNA epigenetic markers as they offer the possibility of an objective confirmation of what cell type the DNA profile is originating from. If proven, the methodology could replace traditional serological approaches to body fluid confirmation.”

— Mark Powell M.Sc., F-ABC
Crime Lab Manager, San Francisco Police Dept.

Problem and Solution Synopses

The identification of body fluids recovered from crime scenes can provide valuable information to further aid investigations. The biological origin of body fluids can facilitate the identification of donors and reconstruction of crime scenes. Current methods used in operational forensic laboratories to identify body fluids lack sensitivity and specificity (e.g. immunological, microscopic, chemical). As such, there is a need in the field to develop easy, reliable, and robust tests for body fluid identification.

Dr. Bruce McCord at Florida International University (FIU) and colleagues at the University of Southern Mississippi are investigating the role of epigenetic modification in the specific characterization of different body fluids. Epigenetic modification refers to changes in gene expression not attributed to changes in genetic material. Dr. McCord has identified DNA methylation patterns and subsequently developed epigenetic methylation markers for the detection of different tissue types present in body fluids and dried stains recovered from crime scenes. A method developed using those markers provides clear, quantitative results and has been shown to effectively distinguish between tissue types, with the added benefit of sample stability over time. The markers and methods from this research can be applied to establishing the source identity of single and mixed biofluids at crime scenes.

Key Benefits

- ▶ Produces clear and distinguishable differences between tissue types with sensitivity approaching 1 ng/μL of genomic DNA.
- ▶ Provides for more specificity than currently used protein-based techniques because cross-reactivity between body fluids is not an issue.
- ▶ Workflow fits well into laboratories with pyrosequencing equipment. Further, the method is robust and can be used on samples stored in evidentiary archives.
- ▶ Fits with current DNA analysis methodology, enabling quick, easy interpretation.
- ▶ Drives progress toward the incorporation of epigenetic analysis into the criminal justice system.

NIJ Research

A National Institute of Justice (NIJ) award (2012-DN-BX-K018) contributed to the development of epigenetic markers in forensic casework. With NIJ's support, Dr. McCord's team discovered that certain epigenetic markers display distinct methylation patterns, which can be used for identification of body fluids (e.g. semen, blood, vaginal fluid) and epithelial cells (e.g. buccal, skin). Based on these data, epigenetic information and a customized protocol for the determination of cell-specific tissue typing using DNA methylation patterns were developed.



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Research Support

The research presented in this success story was supported by the National Institute of Justice (NIJ) award 2012-DN-BX-K018: Body fluid identification using epigenetic methylation markers and pyrosequencing.

Disclaimer

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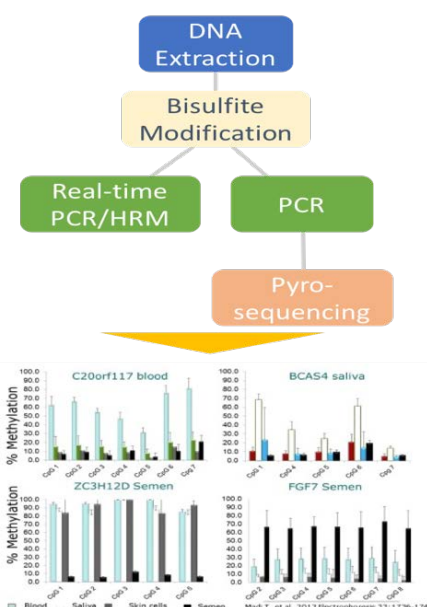
Bringing Research to Practice

In efforts to develop a commercial kit, Dr. McCord's epigenetic DNA methylation marker technology is undergoing additional specificity and validation testing with the Broward County Crime Laboratory and the San Francisco Police Department Forensic Biology and DNA Unit. QIAGEN has kindly provided reagents and pyrosequencing materials to facilitate epigenetic marker evaluation and assay development. Eight peer-reviewed publications and more than 50 citations document Dr. McCord's research on the application of DNA methylation in future crime scene investigation. A U.S. patent (US9702006B1: Materials and Methods for Detecting Vaginal Epithelial Cells) was granted in July 2017.

The Future

Dr. McCord and colleagues are working to optimize and increase the sensitivity of the procedure and are directing effort toward developing a commercial kit and analysis software. In addition, the McCord group is simultaneously working to identify additional loci markers for phenotyping, including methylation patterns reflecting age, weight, and other indicators, such as smoking. The formal method developed under this NIJ award can be used to determine the types of body fluid present in liquid and dried case samples.

To learn more about this technique, please contact Elizabeth Garami at FIU's Office of Technology Management and Commercialization. Stay informed about more products and services by subscribing to the FTCoE newsletter at <https://forensiccoe.org/contact-us/>.



Methodology and analysis easily fit into the general forensic laboratory workflow. Note: HRM = high-resolution melting analysis; PCR = polymerase

Image Credits

Pages 1 and 2—Dr. Bruce McCord

Collaborators

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