DUAL EXTRACTION OF DNA AND MRNA FROM HUMAN BODY FLUIDS FOR FORENSIC ANALYSIS

Courtney Tate[1,3], Rhonda Craig[2], and James Robertson[3]
[1]Oak Ridge Institute for Science and Education, Oak Ridge, Tennessee
[2]DNA Analysis Unit 1, FBI Laboratory Division, Quantico, Virginia
[3]Counterterrorism and Forensic Science Research Unit, FBI Academy, Building 12, Quantico, Virginia

DNA evidence allows for the identification of the person from whom a sample was derived by STR typing but provides little information concerning the tissue origin of a body fluid stain. Identification of the tissue origin of a stain may aid in reconstructing events that occurred at a crime scene. Currently, reverse transcription polymerase chain reaction methods have been developed for definitive identification of body fluids including blood, saliva, semen, menstrual blood, and vaginal secretions. These methods utilize tissue-specific mRNA markers to identify fluid origin in a rapid manner with minimal amounts of sample. In order to conserve evidence and ensure that a DNA profile originates from an identified stain, a method to co-extract both DNA and RNA from the same sample is under investigation. The criteria for co-extraction method selection include sufficient quality and quantity of nucleic acids for molecular typing.

Initial experiments revealed that silica spin-column based RNA/DNA dual extraction kits yielded significantly lower amounts of DNA than phenol-chloroform extraction. Consequently, phenol-chloroform extraction of DNA was modified by either splitting the lysate or splitting the final elution product to obtain DNA and RNA from the same sample. The standard phenol-chloroform extraction method for DNA and a silica spin-column based kit for RNA extraction were performed for each sample set to serve as controls. These studies were performed on various amounts of blood, saliva, and semen stains along with menstrual blood and vaginal secretion stains on cotton swabs. The RNA and DNA yields obtained from the modified phenol-chloroform methods were slightly lower compared to that of the silica spin-column based RNA extraction kit and standard phenol-chloroform DNA extraction method. The DNA isolated from the body fluid stains was analyzed by STR typing, and cDNA was synthesized from isolated mRNA and analyzed by PCR utilizing tissue-specific primers for mRNA profiling. Despite lower RNA and DNA yields compared to the standard extraction methods, the modified phenol-chloroform extraction protocols produced DNA and mRNA of sufficient quantity and quality to generate full STR profiles from the DNA and to obtain positive results for mRNA profiling utilizing tissue-specific primers. In conclusion, dual extraction of DNA and RNA from forensic-type samples appears feasible for the use of STR typing and mRNA profiling.