B65 Application of the MiniFiler™ Kit to the Analysis of Notoriously Problematic Evidence: Degraded Casework Samples, Fired Cartridge Casings, and Telogen Hairs

Susan Greenspoon, PhD, and Katie M. Horsman, PhD,Virginia Department of Forensic Science, Department of Forensic Science, 700 North 5th Street, Richmond, VA 23219*

After attending this presentation, the attendee can expect to learn how the MiniFiler™ kit has been used to successfully develop STR profiles from notoriously degraded, low-level, and inhibited samples. In addition, the attendees will learn how the results obtained with the MiniFiler™ kit compare to those obtained using conventional STR typing kits.

Telogen hairs and fired cartridge cases frequently go unanalyzed in forensic laboratories for DNA evidence due to the high incidence of failure with conventional STR typing kits. The methods and results presented here may impact the evidentiary material accepted and successfully processed by forensic laboratories by demonstrating improved DNA recovery and typing from these notoriously difficult samples.

Degraded samples often result in the inability to produce STR profiles due to the DNA fragment length attenuation. The reduced amplicon size of the recently developed commercially-available MiniFiler™ kit (Applied Biosystems, Foster City, CA) allows for potential analysis of evidence that was otherwise unsuitable for STR analysis. Several casework examples of the use of MiniFiler™ on degraded non-probative evidence will be presented including the analysis of a hair root from a 1992 homicide and the successful profiling of DNA from degraded tissue from a decomposed homicide victim found in a river. In both cases, MiniFiler™ resulted in an informative STR profile, which was not attained with conventional STRs.

In addition to the application of MiniFiler™ to non-probative casework samples, we have also explored its use in the recovery of DNA from other notoriously difficult samples, including fired cartridge cases and telogen phase hairs. In both examples, DNA degradation is suspected to be the cause poor of STR typing success. Gun chamber temperatures, upon firing, are known to reach up to 1980°C. Any DNA present on the cartridge is believed to be degraded, thus conventional STR profiling typically fails. In this study, cartridge casings of varying metallic composition, caliber, and surface area were handled by one of three different individuals, identified as shedders, then loaded into the firearm. The ejected cartridge cases were swabbed using the double swab technique[1] and extracted using an automated DNA IQ method.[2] The resulting extracts were amplified using MiniFiler™, Identifiler™, and PowerPlex® 16 BIO. The results from all three amplifications indicate that the MiniFiler™ kit performed equally well or better than the Identifiler™ and PowerPlex® 16 BIO kits in all samples. In select samples, the MiniFiler™ kit allowed for recovery of useable DNA profiles in samples where the conventional STR kits failed.

Another commonly-encountered type of problematic evidence is telogen-phase hairs. These hairs are characterized by having no identifiable cells at the root end of the hairs,[3] thus making them unsuitable for typical nuclear DNA analysis. During the telogen phase, cells in the hair root undergo apoptosis and dehydration, followed by the keratinization of cellular proteins by proteinases. The hair cell organelles, including the nuclear membrane, are broken down during the process. The nuclear DNA is then subjected to the action of specific deoxyribonucleases, causing the DNA to degrade.[4] As a result, these hairs deemed unsuitable for STR analysis are often directed to mitochondrial DNA analysis instead. This study employed the use of MiniFiler™, to amplify the degraded DNA recovered from the telogen phase hair roots. The performance of the MiniFiler™ kit was compared to the conventional STR kits including Identifiler™ and PowerPlex® 16 BIO. In all cases, the performance of the MiniFiler™ kit was equivalent to or better than the Identifiler™ and PowerPlex®16 BIO kits.

MiniFiler™, Fired Cartridge Casings, Telogen Hair

 ** Presenting Author*