Y6 Using Cell-Free DNA to Improve Short Tandem Repeat (STR) Analysis of Sweat Samples

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Learning Overview: After attending this presentation, attendees will learn how cell-free DNA may be a suitable source of DNA from sweat samples to improve upon STR profiles of low copy number DNA.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by improving upon low copy number samples, such as touch DNA (tDNA), through the use of cell-free DNA.

In the forensic community, tDNA samples are known to be difficult samples to obtain an ample amount of template DNA and produce DNA profiles using STR analysis. Cell-free DNA (cfDNA) is DNA present outside the cell and is found in bodily fluids, such as sweat, saliva, and blood serum. The use of cfDNA has typically been for cancer and prenatal diagnoses of a mother and her child. However, previous research has thought cfDNA could be used to enhance DNA profiles obtained from tDNA samples. For forensic purposes, extractions have not been conducted with a cfDNA extraction kit.

In the first phase of this study, QIAGEN® extraction kits were used to extract DNA from blood serum samples. The two QIAGEN® kits used were the QIAamp® DNA Mini Kit and the QIAamp® Circulating Nucleic Acid Kit. The Circulating Nucleic Acid Kit uses vacuum filtration through a silica membrane with different lysis and wash buffers than the DNA Mini Kit. DNA yields and STR profiles were compared between the two kits and confirmed the Circulating Nucleic Acid kit provided larger amounts of extracted DNA and improved profiles.

In the second phase, sweat samples were collected on glass beads, with a diameter of 0.5cm, then extracted with the Circulating Nucleic Acid Kit. The samples were quantified with Quantifiler™ and genotyped with Promega® Fusion 6C to validate the use of cfDNA for forensic use. Quantitation values found in the second phase were consistent with the quantitation values found in the first phase, using blood serum. STR profiles generated from the extracted and amplified samples showed signs of major and minor contributors. Although Relative Fluorescence Units (RFU) values were small, there were prominent peaks and smaller peaks present in some of the electropherograms. The possible source the minor contributor could be attributed to the handling of items and interactions with others throughout the day.

The third phase of this research will include a larger sample size and will look to find the source of DNA by quantifying and genotyping both the cell pellets and supernatant from the extraction of each sweat sample. If cfDNA can be validated using sweat samples, cfDNA could be a key component in the genotyping of touch DNA samples. The forensic use of cell-free DNA still needs to be validated further, but if quantities and STR profiles of low template number DNA can be consistently reliable using cfDNA, it may lead to stronger evidence and further the use of DNA genotyping.

Cell-Free DNA, Short Tandem Repeat Profiles, Low Copy Number