A176 DNA Purification From Forensic Samples in a Microfluidic Biochip

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After attending this presentation, attendees will be familiar with recent advances in biochip-based DNA extraction and purification protocols that enable forensic sample preparation to be performed rapidly and with minimal user intervention.

This presentation will impact the forensic community by demonstrating biochip-based DNA extraction and purification, a major step towards the development of a fully integrated, samples-in to results- out STR analysis system for both laboratory use and field forward operation. Such a system has the potential to reduce the time, labor, and cost of performing STR analysis.

A major challenge in bringing biochip-based DNA analysis tools to the forensic community has been in developing a robust, easy to operate commercial instrument that offers reliable and reproducible performance. A fully integrated sample-in to results-out biochip-based DNA analysis system specifically for human identification will be discussed. This system comprises three microfluidic modules to perform: (1) DNA extraction, purification, and human specific quantification, (2) multiplexed STR amplification, and (3) separation and detection of the resulting amplicons. In developing such a system, it is critical that each module function at least as well as—and preferably better than—the analogous conventional technology that it is designed to replace. We have previously reported on Genebench-FX™ Series 100, a microfluidic biochip-based separation and detection system that is ruggedized for operation in the laboratory and field. The instrument allows multiplexed STR amplification products to be separated and detected with single basepair resolution, high precision, and high sensitivity in under 15 minutes.

We will report on the development of a module for rapid biochip- based DNA extraction and purification. Single use disposable microfluidic biochips capable of simultaneously purifying 8 or 16 samples were designed and fabricated. Fluidic manipulation within the biochips was accomplished with active and passive valves, pumps, and air pressure. A purification membrane incorporated within the biochip binds DNA from the lysate. Subsequent washing of the bound DNA removes contaminants and purifies the bound DNA. Purified DNA eluted from the membrane meets volumetric and quality requirements for subsequent biochip processing. The extraction and purification protocol is automated by instrumentation developed to apply pressure and vacuum to the input ports of the biochip in a sequential manner according to a computer-controlled script. Optimization of the reagents and protocol allows simultaneous purification of 8 or 16 samples in 10 minutes. Biochip-purified DNA is quantified conventionally and amplified by rapid biochip-based PCR, and amplification products are characterized by separation and detection on Genebench-FX™ Series 100.

Data will show that non-probative and mock casework samples including buccal swabs, dried blood, and whole blood samples are purified with high efficiency and that the resulting DNA is compatible with subsequent PCR amplification and separation and detection. It is demonstrated that biochip-based DNA purification is well-suited for incorporation into a fully-integrated microfluidic forensic DNA analysis system.

STR Analysis, DNA Extraction and Purification, Biochip

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