Validation of the Automated Differex™ System

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Over the past few years the introduction of robotics into the forensic DNA field has enabled both casework and convicted offender laboratories to significantly increase efficiency on routine procedures in both pre-amplification and post-amplification laboratories. However, this increase in efficiency through automation has not yet been realized in the most laborious step of processing a sexual assault evidence collection kit, namely the separation of sperm and epithelial cells during a differential extraction. Internal data indicates that extraction of differential samples represents 30% of all hours worked in a typical sexual assault case and separation is by far the single most labor-intensive step in the process. From a quality perspective, manual separation involves significant sample handling, requires numerous tube transfers and the degree of separation often varies between analysts. Therefore, the need for a reliable and reproducible method to reduce processing time and sample manipulation from an automated differential extraction procedure is high. The introduction of Promega's Automated Differex™ System for differential separation of epithelial and sperm cells, which separates up to 48 samples at once, has the ability to simultaneously increase both quality and throughput of a laboratory, therefore reducing the backlog of sexual assault kits.

Our laboratory recently validated Promega's Automated Differex™ System using the Biomek® 2000 for differential separation of epithelial and sperm cells from sexual assault samples. This automated method uses the DNA IQ™ Resin to cap the sperm pellet after differential lysis of the epithelial cells and centrifugation. A flat top magnetic separation device is used to keep the capped sperm pellet in place during the wash steps. Overall four wash steps are performed and a separation solution is added to the samples prior to the last wash in order to remove any residual buffer and epithelial cell DNA from the capped sperm pellet. At the conclusion of the automated method, the resulting epithelial cell DNA and sperm pellet are ready for extraction. The 48 sample procedure for separation takes just over two hours and requires minimal human intervention.

Internal validation included studies on reproducibility, sensitivity, known and mock non-probative samples, column comparison, and cross-contamination. Differential separation with the Automated Differex™ System was reproducible and reliable. Full major male profiles were produced from samples with 1:100 dilutions of semen. Even samples with a 1:1000 dilution of semen exhibited male DNA, verifying that loss of the sperm pellet would be rare.

Comparable results have been achieved with casework samples that have been processed in parallel using conventional methods of differential separation and the Automated Differex™ System. Compared to current procedures, it is estimated that one analyst continuously running this automated method of differential extraction will achieve a productivity level equal to five analysts performing a manual separation during the differential extraction. Therefore implementation of the Automated Differex™ System has the potential to increase quality and efficiency by reducing processing time and analyst sample handling while still producing reliable results.

Keywords: Differential Separation, Automated Differex™ System, Robotics