B201 Automation of Casework and Forensic Reality

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After attending this presentation, attendees will become familiar with some of the challenges encountered while implementing the automated process for general casework at the RCMP. Learning about the limitations of the DNA extraction process based on magnetic beads will assist them in creating options for samples that are incompatible with automation.

This presentation will impact the forensic community and/or humanity by demonstrating how the adoption of an automated approach for casework processing provides immediate benefits to the community. In the past year, there has been an increase in the number of samples processed with a concomitant reduction in turnaround time. Over the course of almost four years, automated protocols, integrated with a LIMS-based computer tracking system, have been developed for direct DNA extraction, differential DNA extraction, DNA quantification, sample normalization, PCR setup, and post-PCR setup. The global automation system has been in place for close to one year now and the sharing of experience and the identification of the limitations of it should benefit forensic scientists currently contemplating automation for casework.

This presentation discusses the challenges encountered while implementing automation for general casework at the RCMP. Both advantages and limitations of a semi-automated DNA extraction process based on magnetic beads will be presented in a lessons-learned approach, which will benefit forensic laboratories working in this field.

Automated DNA extraction in the forensic laboratories was introduced in a stepwise modular approach. In 2000, the RCMP implemented a successful fully integrated and automated approach for the processing of convicted offender samples submitted to the National DNA Data Bank of Canada. This process combines the chemistry specific to FTA® cards and Sample Tracking and Control System™ (STaCS™). The process was adapted to work on TECAN Genesis RSP 150/8 robotic workstations equipped solely with non-disposable tips. In 2004, a fully integrated and semi-automated approach was successfully implemented for the processing of high volume DNA casework using non-suspect Break and Enter samples. The process was based on DNA extraction using Promega DNAIQ™ magnetic beads and DNA quantification using the ABI Quantifiler™ assay. The Key to success was the integration of specific robot tip washing routines designed to prevent cross-contamination of samples while ensuring that these measures did not add significant amount of time to the overall process. A key secondary advantage was that the fixed tip approach would also significantly decrease the overall cost of automated processing compared to protocols using proprietary liquid sensing disposable tips. The next increment for the automated forensic DNA objective was to develop a Sample Normalization module and an automated differential DNA extraction protocol which would accommodate all casework-type samples. In September 2005, the RCMP initiated the process for general casework samples using automated extraction. Some of the challenges that were encountered while processing casework samples included: 1) occasional imbalances in the heterozygous allele peak height ratio noted in STR profiles (it was noted that the use of the ABI DNA standard for real-time PCR quantification overestimated the amount of DNA present in the samples; reverting to the K562 standard solved the issue), 2) lack of success for some hemochromagen-positive questioned samples, some semen-positive samples and some known FTA samples with biological samples processed using DNAIQ™ magnetic beads. Each operational challenge noted above was evaluated by simulation experiments within the R&D environment. This resulted in recommendations involving sample size and adjustments in lysate volume to secure results using a manual route. Monitoring of the automated extraction process over the last 11 months indicates an increase in the overall number of samples processed and the successful processing for the majority of samples encountered in operational casework. However, the option of manual extraction remains and additional optimization of the automated processing will be inevitable since forensic casework samples will encounter many unknown environmental insults and new challenges previously not identified to either automated or manual processing of biological exhibits.

The adoption of an automated approach for casework processing provides immediate benefits to the

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forensic laboratory. This should increase the number of samples processed, reduce the manual intensive nature of DNA processing, and ensure tracking of each sample throughout the process: direct DNA extraction, differential DNA extraction, DNA quantification, sample normalization, PCR setup, and post-PCR setup. Routine processing of large numbers of samples will free up time for solving problems encountered with challenging exhibits. This automated approach for casework has been in place for close to one year now and the sharing of experience and the identification of the limitations and advantages should benefit forensic scientists currently contemplating automation.

Automation, Casework, Magnetic Beads

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