NOVEL Y-SCREENING AND SPERMTRAP™ DIFFERENTIAL EXTRACTION: STREAMLINED SEXUAL ASSAULT KIT PROCESSING

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Here we report novel approaches to screen sexual assault samples directly, without DNA extraction, from a small portion of an evidence sample for the presence of male DNA using a novel high-copy number Y-marker[1]. Our qPCR male DNA screening method, InnoScreen Y, is able to detect Y chromosomal DNA to 0.312 pg/µL, is easily automatable, and uses a 96 well format that allows for the efficient screening of a high number of samples simultaneously. This method provides a downstream correlation with the profiling results obtained with commonly employed STR and Y-STR genotyping systems.

Once testable male DNA has been identified, forensic laboratories that perform differential extractions run into difficulties processing sexual assault kits due to low quantities of DNA resulting in low quality, mixed DNA profiles that are frequently difficult to interpret. The conventional differential extraction process has a large number of manipulations that increases the risk of sample loss and/or contamination. Our novel sperm recovery method, SpermTrap™, addresses these problems by utilizing a matrix derived separator that functions to effectively capture sperm cells, while enabling efficient flow through of digested epithelial cell DNA. This method provides an efficient, simple, and fast process which significantly increases a forensic laboratory's ability to obtain "clean" sperm fraction DNA profiles while minimizing sample manipulations, thus providing a rapid, reproducible procedure that is easy to implement in a single-tube format.

Evaluation of the effectiveness of this process was performed using mock, dried rape kit swabs containing both epithelial and sperm cells for swabs where there is as little as 1 ng of Sperm DNA on a swab. The optimized process effectively recovered between 70-90% of the sperm DNA from mock SAK swabs. SPRED[2] values (male DNA recovery percentage/female DNA swab carryover percentage) for samples with a swab M: F ratios (R_{SW}) of ~1:180 and ~1:2100 were 1806 and 1278 respectively. This allows for easier recovery of DNA and interpretation of profiles for SAK kits.

Combining this novel extraction technology with a male DNA screen improves a laboratory's capacity and throughput by both decreasing initial processing steps and minimizing rework.

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[2]S.B. Klein, M.R. Buoncristiani. Forensic Science International: Genetics 29 (2017) 109-117.