

DNA CHIPS, MICRO CE, AND HUMAN ID

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DNA casework in the FBI laboratory entails the analysis of STR polymorphisms using the ABI Prism® 310 Genetic Analyzer (PE Biosystems) and mitochondrial DNA sequencing using the ABI Prism® 377 DNA Sequencer (PE Biosystems). While new technologies could provide improvements in the analytical procedures, a greater impact on reducing total sample processing time could be achieved with use of higher-throughput systems for sample preparation and the integration of sample preparation with analysis. In fact, using current procedures, the preparation of a sample for DNA analysis (that is, DNA isolation through amplification of STRs or cycle sequencing) takes up more than 80% of total sample processing time. Throughput, as well as time, labor and cost, in DNA casework and convicted offender database operations could be improved considerably with usage of single-instrument technology that couples DNA isolation to amplification to detection (so-called "sample-to-answer" capability). The integrated system would be comprised of a microstructured device with fluid circuits in which the solubilized sample is processed through to detection. Detection could be achieved by hybridization to DNA microarrays or by micro-capillary electrophoresis (micro CE). DNA microarray chips can be used to analyze SNPs or STRs by mass spectrometry or hybridization. While DNA chips offer several advantages, there are limitations that could preclude their utility for analyzing some forensic samples. For example, STR microvariants ("off-ladder alleles") for which there is not a specific probe would not be detectable, thus resulting in allele dropout. Also, chips with mass spectrometry-based detection are not well-suited for the analysis of samples with multiple contributors and have size limitations that preclude typing of the larger STR alleles. Micro CE, however, would support typing of the core CODIS STR loci and offer numerous advantages, including potential compatibility with the current STR kits that are validated for forensic usage. Micro CE could also be readily integrated into a sample-to-answer system. Several companies have developed instrumentation for DNA chip analysis and micro CE. The FBI FSRU has evaluated these technologies and their applicability for the forensic laboratory. Prospects for these new technologies will be discussed.