Applied Biosystems

October 2006 Customer Corner

MiniSTRs: Past, Present, and Future

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DNA molecules that are exposed to water and/or heat will over time begin to break down into smaller pieces. This degradation occurs due to bacterial, biochemical or oxidative processes. A number of studies have demonstrated that successful analysis of degraded DNA specimens from mass disasters or compromised forensic evidence improves with smaller sized PCR products. For example, in 1994 the Forensic Science Service noted that smaller STR loci worked more often on biological remains recovered from the Branch Davidian fire. The first major effort to purposefully reduce STR amplicon sizes was for use in time-of-flight mass spectrometry, where detection sensitivity improved dramatically with PCR products less than 100 bp in size. Later many of these "miniSTR" primers were labeled with fluorescent dyes and used to aid identification of World Trade Center victims. A timeline covering the development of miniSTRs may be found at http://www.cstl.nist.gov/biotech/strbase/miniSTR/timeline.htm.

Using their 5-dye chemistry and mobility modifier technology, Applied Biosystems has developed a miniSTR kit capable of amplifying 8 core STR loci and amelogenin with reduced PCR product sizes relative to current commercial kits. This kit, which includes an improved PCR master mix, should greatly aid efforts to recover results from degraded DNA samples. However, it is important to keep in mind that because different PCR primers are in use with the miniSTR kit relative to previous AmpFℓSTR® kits, discordant results may occur due to primer binding site mutations that cause allele dropout.

Unfortunately, amplicon size and the ability to amplify extremely degraded DNA molecules was not considered when the 13 CODIS core STR loci were selected, and thus several of them have a large number of repeats (e.g., D21S11) or wide allele ranges (e.g., FGA) that are not optimal for generating small amplicons. An additional 26 polymorphic STR loci, which contain narrow allele ranges and when PCR-amplified are less than 150 bp, have been recently characterized at NIST. Equally important, all of these miniSTR loci are located on separate chromosomes or are genetically unlinked from the widely used 13 CODIS markers and thus may be used in conjunction with them. Several of these new miniSTR loci—namely, D2S441, D10S1248, and D22S1045—have been recommended by leaders in the European forensic DNA community for adding to their core genetic systems used in human identity testing. More information on these new miniSTR loci is located at http://www.cstl.nist.gov/biotech/strbase/newSTRs.htm.

The utility of miniSTR assays has been confirmed in intra- and inter-laboratory studies involving degraded bone samples and aged blood and saliva stains. In all cases, success rates in recovering information from compromised DNA samples improve with miniSTR systems compared to conventional STR kits.

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The author, John M. Butler, is funded by the National Institute of Justice through interagency agreement 2003-IJ-R-029 with the NIST Office of Law Enforcement Standards. Points of view in this document are those of the author and do not necessarily represent the official position or policies of the US Department of Justice. Certain commercial equipment, instruments and materials are identified in order to specify experimental procedures as completely as possible. In no case does such identification imply a recommendation or endorsement by the National Institute of Standards and Technology nor does it imply that any of the materials, instruments or equipment identified are necessarily the best available for the purpose.