Blood on FTA™ Paper: Does Punch Location Affect the Quality of a Forensic DNA Profile?

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Abstract:

Forensic DNA profiling is widely used as an identification tool for associating an individual with evidence of a crime. Analysis of a DNA sample involves observation of data in the form of an electropherogram, and subsequently annotating a DNA "profile" from an individual or from the evidence. The profile obtained from the evidence can be compared to reference profiles deposited in a national DNA database, which may include the potential contributor. Following a match, a random match probability is calculated to determine how common that genotype is in the population. This is the probability of obtaining that same DNA profile by sampling from a pool of unrelated individuals. Each state has adopted various laws requiring suspects and/or offenders to submit a DNA sample for the national database (such as California's

law that all who are arrested must provide a DNA sample). These profiles can then be associated with past unsolved crimes, and remain in the database to be searched in the event of future crimes. In the case of database samples, a physical sample of the offender' s DNA must be kept on file in the laboratory indefinitely so that in the event of a database hit, the sample is able to be retested. Current methods are to collect a buccal swab or blood sample, and store the DNA extracts under strict preservation conditions, i.e. cold storage, typically -20° C. With continually increasing number of samples submitted, a burden is placed on crime labs to store these DNA extracts. A solution was required to help control the costs of properly storing the samples. FTA™ paper was created to fulfill the need for inexpensive, low maintenance, long term storage of biological samples, which makes it ideal for use with convicted offender DNA samples. FTA™ paper is a commercially produced, chemically treated paper that allows DNA to be stored at room temperature for years with no costly storage facilities or conditions. Once a sample is required for DNA testing, a small disc is removed and is to be used directly in a PCR reaction. A high quality profile is important for comparing suspect profiles to unknown or database profiles. A single difference between a suspect and evidentiary sample can lead to exclusion. Unfortunately, the DNA profile results yielded from the direct addition have been unfavorable. Thus, most crime laboratories will extract the DNA from the disc, leading to additional time and cost to analyze a reference sample. Many of the profiles from the direct addition of an FTA™ disc result in poor quality profiles, likely due to an increase in PCR inhibitors and high concentrations of DNA. Currently, standardized protocols regarding the recommended locations for removal of a sample disc from a bloodspot on an FTA™ card does not exist. This study aims to validate the optimal location by comparing DNA profiles obtained from discs removed from the center, halfway, and edge locations of a bloodspot from 50 anonymous donors. Optimal punch location was first scored on the number of failed, partial or discordant profiles. Then, profile quality was determined based on peak characteristics of the resulting DNA profiles. The results for all three disc locations were 5.3% failed amplifications, 4.2% partial amplifications, and one case of a discordant profile. Profile quality for the majority of the samples showed a high incidence of stutter and the absence of non-template adenylation. Of the three disc locations, the edge of the blood stain was ideal, due to a presumably lower concentration of DNA and likely more dilute amount of the PCR inhibitor heme. Therefore, based on the results of this study, there is a greater probability of success using a sample from the edge of a blood stain spotted in FTA™ paper than any other location of the FTA™ card.

Description:

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