ParaDNA®: Advance Knowledge to the Investigator

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Abstract

ParaDNA® indicates whether samples collected at the crime scene contain human DNA and which of these are most likely to deliver investigative leads. It only takes 75 minutes to screen up to four samples and acquire this vital advance knowledge using fluorescent HyBeacons™ technology. The results indicate whether human DNA is present in sufficient quantity to generate a conventional STR profile upon submission to the laboratory. In addition, the sex of the sample donor is determined. ParaDNA does not supplant existing STR analysis, but augments the process and could save significant time and cost by effectively directing the investigative process. Using an innovative sample collector, minimal training is required to enable investigators to collect, assemble and analyze DNA. This poster presents the validation data that indicate the potential utility of the system in the United States, by screening several touch and saliva mock evidence samples.

ParaDNA® Unit Utility

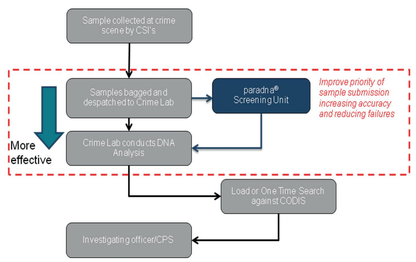


Fig.1: ParaDNA® Unit Utility schematic (Photo courtesy of LGC Forensics)

Using today's technology:
Investigators process the crime scene and send all materials to the lab for analysis. Depending on the number of samples and laboratory load, processing can take considerable time and resources.

Using ParaDNA Screening Unit:
Investigators collect numerous swabs and subject four stains to ParaDNA Screening system to determine whether the samples contain human DNA and the gender of the donor. In 75 minutes, they will know if the selected samples are appropriate for further testing at the lab or if they need to screen additional samples.

The ParaDNA® Process

para»dna®

ParaDNA Sample Collector - unique 4-nib design

Sample either directly from the evidence item or indirectly subsample from a cotton or rayon swab

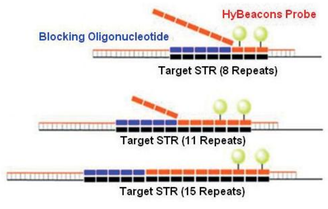
Sampled 4-nibs inserted into the preloaded reaction plate

The PCR chamber is sealed with no further human interaction

Reaction plate loaded onto ParaDNA instrument. Up to 4 samples can be processed independently or in parallel

Fig.2: The ParaDNA Process, from collection to instrument loading (Photo courtesy of LGC Forensics).

HyBeacons™ Biochemistry



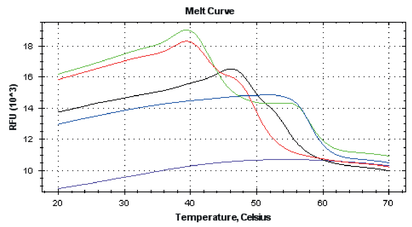
The ParaDNA® Screening Test uses an adapted version of LGC's proprietary HyBeacons® fluorescent probe technology. Fluorescent dye-labeled probes target informative STR markers with high heterogeneity to ensure optimum DNA analysis.

Amplification
- Target Areas:D16, TH01 & Amelogenin
- The collected sample is added to the reaction tube without preparation. The reagent mix contains all the elements to perform a direct PCR and to analyze the STRs using a DNA Melt analysis.

Melt Measurement
- The longer STRs have stronger affinity to our probe.
- As the temperature is increased, the smaller STRs detach from the probe at lower temperatures.
- As the DNA become single stranded, the probes decrease in fluorescent signal.

Fig.3: Schematic of the HyBeacons™ fluorescent probe technology applied in the ParaDNA Screening Test (Figure courtesy of LGC Forensics).

a.



b.

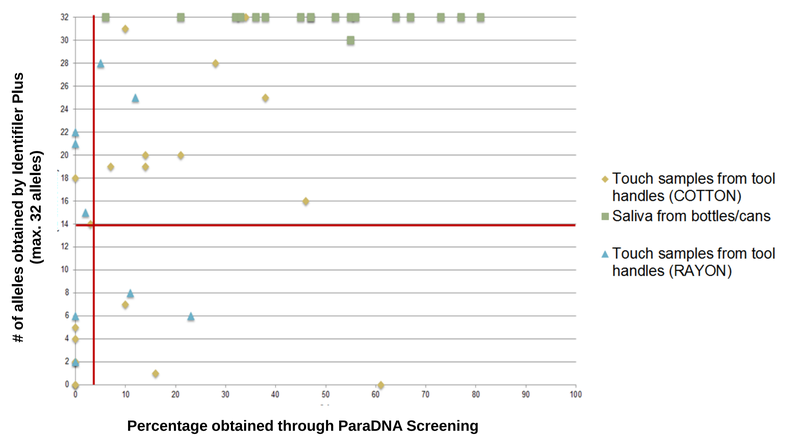
Fig.4: The ParaDNA Screening Test Instrument results a) detected by the instrument, b) visible to the user. (Photo courtesy of LGC Forensics).

Materials & Methods

Touch Samples: Touch samples were collected from 29 tools. Each tool was manipulated for 5 min by a single subject. After 24-48 hours, the area touched by the subject was swabbed using a wet cotton or rayon swab, followed by a dry cotton or rayon swab. The swabs were stored at -20° C until screened using the ParaDNA Screening Assay (LGC Forensics, Oxon, UK).
Saliva Samples: A total of 18 drink bottles and cans were wet/dry swabbed 24- 48 hours after usage. The swabs were stored at -20° C until screened using the ParaDNA Screening Test (LGC Forensics, Oxon, UK).

To assess the accuracy by which the ParaDNA Screening System detects DNA on the mock evidence items, each swab underwent extraction, quantification and profiling using the AmpFlSTR®Identifiler®Plus (Applied Biosystems, Foster City, CA).

Results



- **Touch samples:** ParaDNA® scores: 0% - 61%. Four false negative (no DNA detected by ParaDNA unit, but ≥14 alleles generated by Identifiler Plus) and five false positive (DNA detected by unit, but <14 allele peaks generated by Identifiler Plus) detection scores were observed.
- **Saliva samples:** ParaDNA scores: 6% - 81%. All scores were true positive, where DNA was detected by the ParaDNA Unit and a profile of ≥14 alleles was obtained using Identifiler Plus.

Fig. 5: Showing the correspondence between the percentage obtained through ParaDNA screening and obtaining successful profiles using AmpFlSTR®Identifiler®Plus.

Discussion

The ParaDNA® screening system was tested using two sample types: saliva from drinks bottles or cans (collected with cotton swabs) and also touch samples from tool handles (collected with cotton or rayon swabs). The results from saliva samples had a 100% true positive prediction, leading to successful DNA profiles for all samples. Touch samples showed 4 false negatives and 5 false positives, with accurate prediction of the success/failure of profiles at a rate of 69%. These data suggest that ParaDNA® screening could become a permanent feature in forensic DNA analysis as a rapid detection system that can reliably predict the success of STR profiling. Such a tool would reduce backlog of evidence, allow intelligent prioritizing of samples, as well as reducing waste in both reagents and time. Further testing of a larger sample size is underway as well as additional sample types such as dried blood.

Acknowledgements

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