Collection, Concentration and Long Term Room Temperature Stabilization of Forensic DNA in Liquid Format is a Reality

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1. Introduction

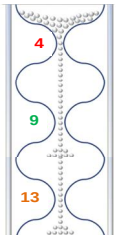
Crime scene investigators are trained to air-dry evidentiary samples following swab-based collection. Drying swabs can lead to irreversible binding of DNA to the swab material resulting in low DNA recovery. However this step can be challenging, especially in areas of high humidity and air moisture content. There are several factors affecting DNA integrity and yields of evidentiary samples:

- ❑ **Irreversible binding to swab material**
- ❑ **Nucleases**
- ❑ **Microbial contamination**
- ❑ **Temperature fluctuations**
- ❑ **Heat**
- ❑ **Humidity**
- ❑ **UV light**
- ❑ **Improper collection**
- ❑ **Storage conditions and length of backlog**
- ❑ **Transport conditions & transit time**

Mawi has developed iSWAB-ID, an efficient liquid-based sample collection system which utilizes swabs. iSWAB-ID enables long term room temperature stabilization of the collected sample at the point of collection while ensuring proper chain of custody. This system maximizes sample recovery and simplifies sample processing extensively over current practices, allowing for Enhanced ID Profiling.

Evidentiary Material Processing Bottlenecks

Step #	Description	Time Spent (mins)
1	Screen	
2	Identify	
3	Collect	
4	Dry	30 min/Sample
5	Package	
6	Reporting and documentation	
7	Transport	
8	Store	
9	Cut swab/ Punch FTA Card	10 min /Sample
10	Lyse	
11	Extract	
12	Quantify	
13	STR profiling	20-60% Further Analysis
14	Data Analysis	
15	Report	



2. Objectives

- To assess the efficiency of ISWAB-ID in the collection, concentration, and long-term room temperature stabilization of both reference and evidentiary samples by assessing the usability of purified DNA in human ID-STR profiling assays.
- To assess the stability of ISWAB-ID samples during multistop-global transport process

3. Experimental Design

Collect reference and mocked evidentiary samples into the iSWAB-ID Sample Collection Device (400 µL)

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Transport to processing lab by standard mail

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Store samples at room temperature

↓

100 µL aliquoted from each iSWAB-ID sample post collection

2-Days | **14-Days** | **6-Months (World Traveler)**

San Francisco, CA, Baltimore, MD, Dallas, TX, Grapevine, TX, San Francisco, CA, London, UK — Riyadh, Saudi Arabia, Khubar, Saudi Arabia, London, UK, San Francisco, CA, Newark, CA

BioChain®

DNA Extraction AnaPrep-12 (Blood 200)

BioChain®

Quantify DNA (QIAGEN Investigator Quantiplex)

Sorenson Forensics

STR profiling (Promega PowerPlex 16 HS) and analysis

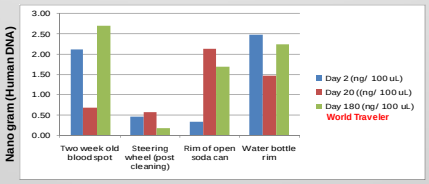
4. Results

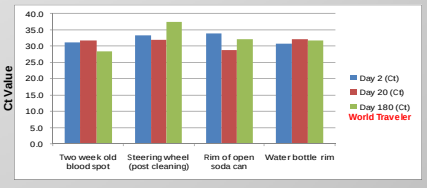
I- DNA Extraction and Human DNA Quantification

iSWAB-ID Efficiently Recovers and Stabilizes Human DNA from Both Reference & Evidentiary Samples in Long Term, Room Temperature Storage from Low, Medium and High Copy Number Samples

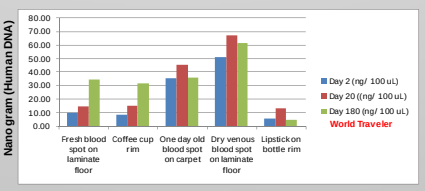
DNA concentration from swabs post ISWAB-ID collection: ND

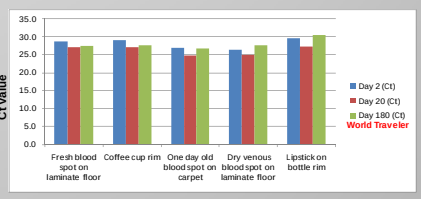
A) **Low Copy Samples**



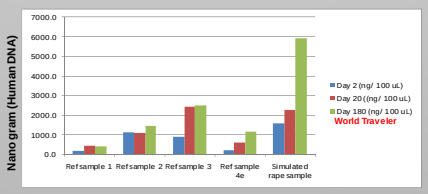


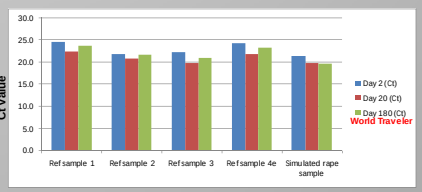
B) **Medium Copy Samples**





C) **High Copy Samples**





D)

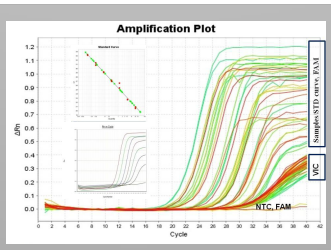
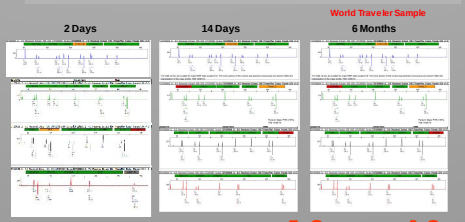


Fig 1. A selection of real-world, reference, and simulated evidence samples was collected in iSWAB-ID devices and stored at room temperature. DNA was extracted from 100 µL aliquots, using the AnaPrep Blood DNA extraction kit on AnaPrep 12 instrument, either two days or two weeks after collection. In all cases, PCR-amplifiable Human DNA was recovered from stabilized samples after storage for two weeks at room temperature. All samples were quantified by QIAGEN Investigator Quantiplex Kit targeting Human DNA. A) Low copy samples, B) Medium copy samples, C) High copy samples, D) Amplification plot for all samples including standard curve, VIC, (two & 14 days and 6 months samples), ND: Not Detected

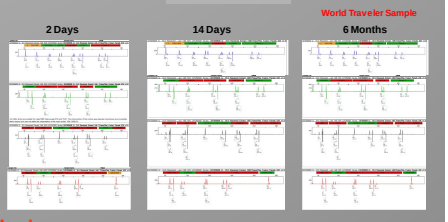
II- STR Profiling and Analysis with Promega PowerPlex 16 HS

First Pass STR Profiling Analysis Samples are Suitable for Comparison Purposes

Lipstick on a Cup Rim: An Example of Touch DNA Sample



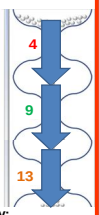
Simulated Rape



5. Summary & Conclusions

Evidentiary & Reference Samples Processing Bottlenecks: All Resolved with iSWAB-ID

Step #	Description	Time Spent (mins)
1	Screen	
2	Identify	
3	Collect	
4	No Drying Required	0 min/Sample
5	Package	
6	Reporting and documentation	
7	Transport	
8	Store	
9	Cut swab/ Punch FTA Card	0 min/Sample Not Applicable
10	Lyse	
11	Extract	
12	Quantify	
13	STR profiling	5-10% Further Analysis
14	Data Analysis	
15	Report	



Significant Improvement on Processing Efficiency:
- ✓ Faster Collection
- ✓ Higher First Pass Rate
- ✓ Higher Sample processing Throughput

- **The iSWAB-ID sample collection device efficiently recovered and stabilized DNA of forensic significance in liquid format at the point of collection.**
- **DNA collected and stabilized in iSWAB-ID at ambient temperature remained of sufficient quality to analyze for at least 6 months.**
- **Unlike samples processed from swabs, samples collected with iSWAB-ID yield more DNA allowing multiple analytical runs and sufficient material for archiving.**
- **Extended ambient temperature shelf-life allows cost and space-saving storage and eliminates sample degradation resulting from excessive backlogs.**