

Swap the Swab: Improved DNA Stability and Recovery of Evidentiary Samples

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Introduction

In recent years, a combination of new technologies being introduced into the market and the great impact of the use of DNA to solve crimes has led to both increased reliance on DNA and more collections. One often overlooked area is the collection, transport, recovery and storage of biological evidence from crime scenes. This presentation will introduce the Bode BioSafe™ Collection System that can improve sample recovery for DNA analysis from crime scenes.

Cotton swabs are the primary collection devices used to collect biological material. After collection, swabs are often dried and placed in coin envelopes or swab boxes where the swab is unprotected from contact with the envelope or box, but also unprotected from external environmental conditions. Biological materials, even when stored properly, can break down or degrade, resulting in less than desirable results. This can be exacerbated if the sample is limited in quantity or compromised from the start. The Bode BioSafe Swab contains a cotton swab pre-treated with preservative solution that prevents DNA degradation from a variety of factors including enzymes, and bacteria. The result is the ability to resist any degradation that may occur in the weeks, months, or years that may pass before the sample is analyzed.

A mock crime scene was created with different surfaces and biological fluids. Samples were collected with both the BioSafe Swab and a cotton swab. Samples were stored at 22°C with high and low humidity and 65°C low humidity over 56 days (3 year accelerated study).

Materials

- Bode BioSafe Swabs and Standard Cotton Swabs
- Blood and Saliva Stains
- Wood, Bricks, Shoes, Plastic Knives, and Metal Surfaces
- Controlled and Uncontrolled Storage Conditions
 - High Heat
 - High Humidity
 - Outdoors
 - Ambient Conditions



Methods

Sample Application and Collection

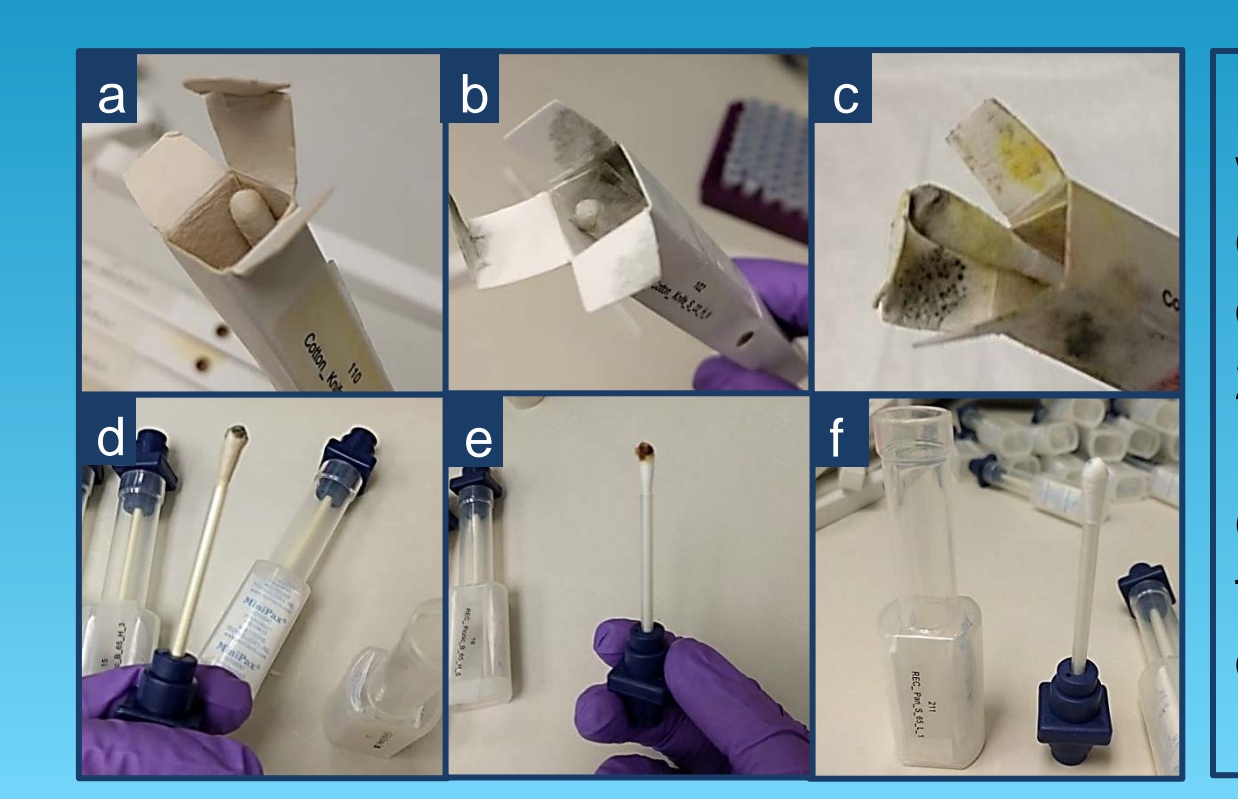
- Blood and saliva stains created on each surface and allowed to dry (25µl)
- Wet/dry collection using BioSafe or standard cotton swab
- Storage Conditions
 - 22°C and 65°C
 - Low (<10%), Ambient (30-40%), and High (>60%) Humidity

Sample Processing

- ☐ Extraction with QIASymphony® SP and the QIASymphony DNA Investigator® Kit
- ☐ Quantification with ABI Quantifiler™ Trio Kit
- ☐ Concentration if needed
- ☐ Amplification with PowerPlex® Fusion
- ☐ CE Analysis with ABI 3500xL Genetic Analyzer

Investigator is a registered trademark of QIAGEN Group.
PowerPlex is a registered trademark of Promega Corporation.
Quantifiler is a registered trademark of Applied Biosystems.

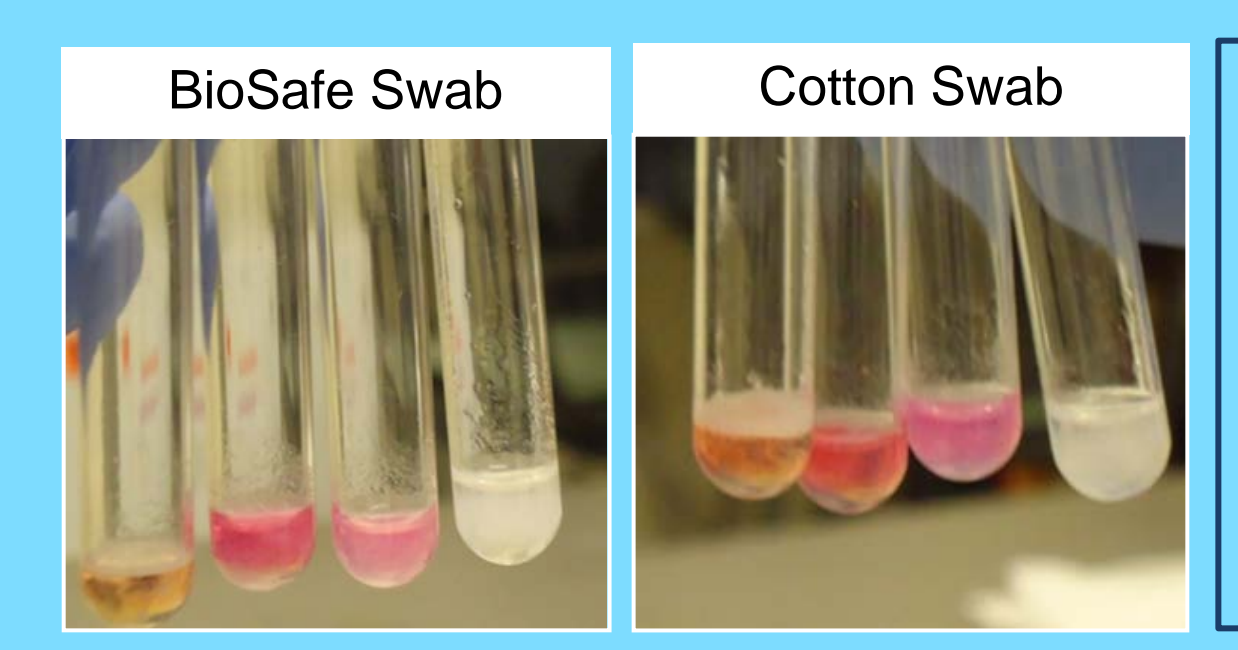
Observation



Fungal growth was observed on cotton swabs after one month at 22°C in a high humidity condition. No fungal growth was observed on BioSafe Swabs.

Serology

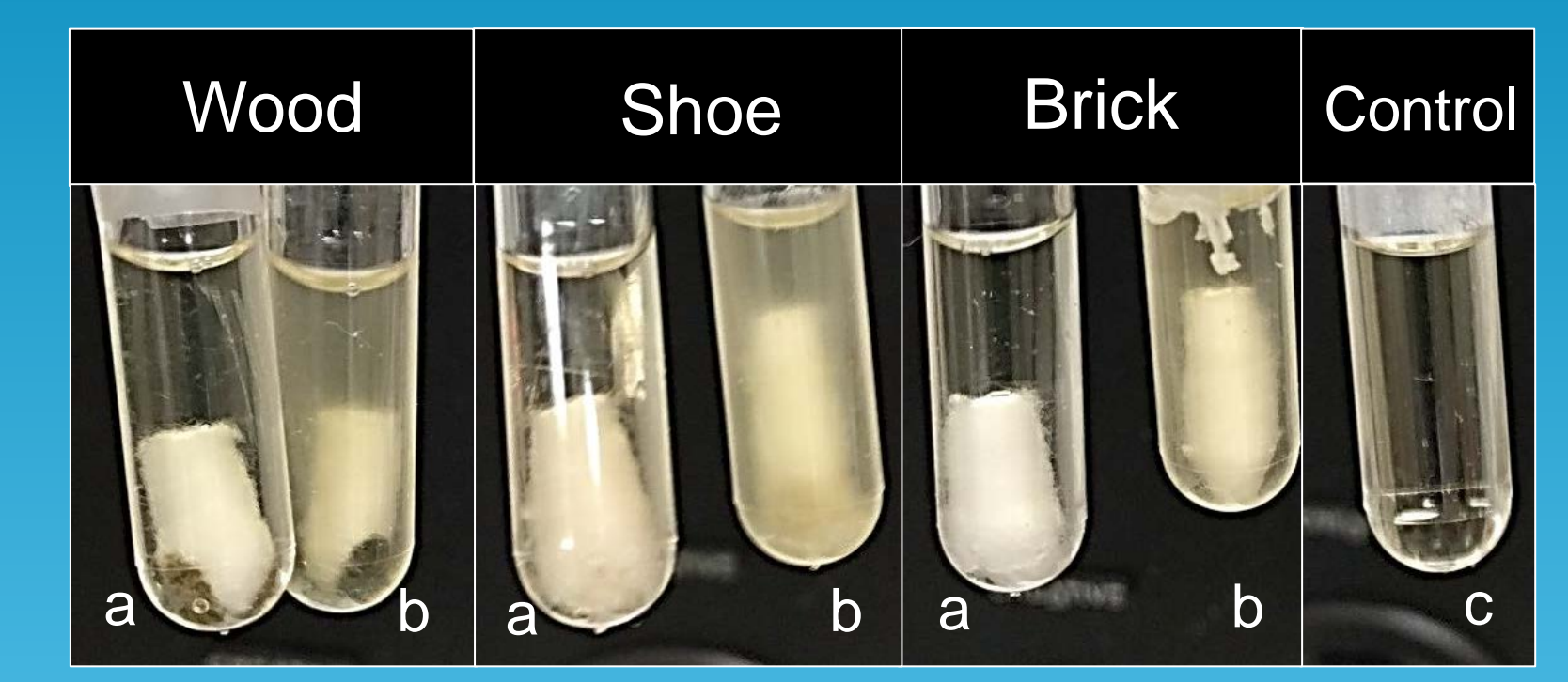
BioSafe is tested to be compatible with presumptive and/or confirmatory tests for saliva, blood, and seminal fluid.



Phenolphthalein Testing (left to right) Neat blood, 1:20, 1:100, and blank swab

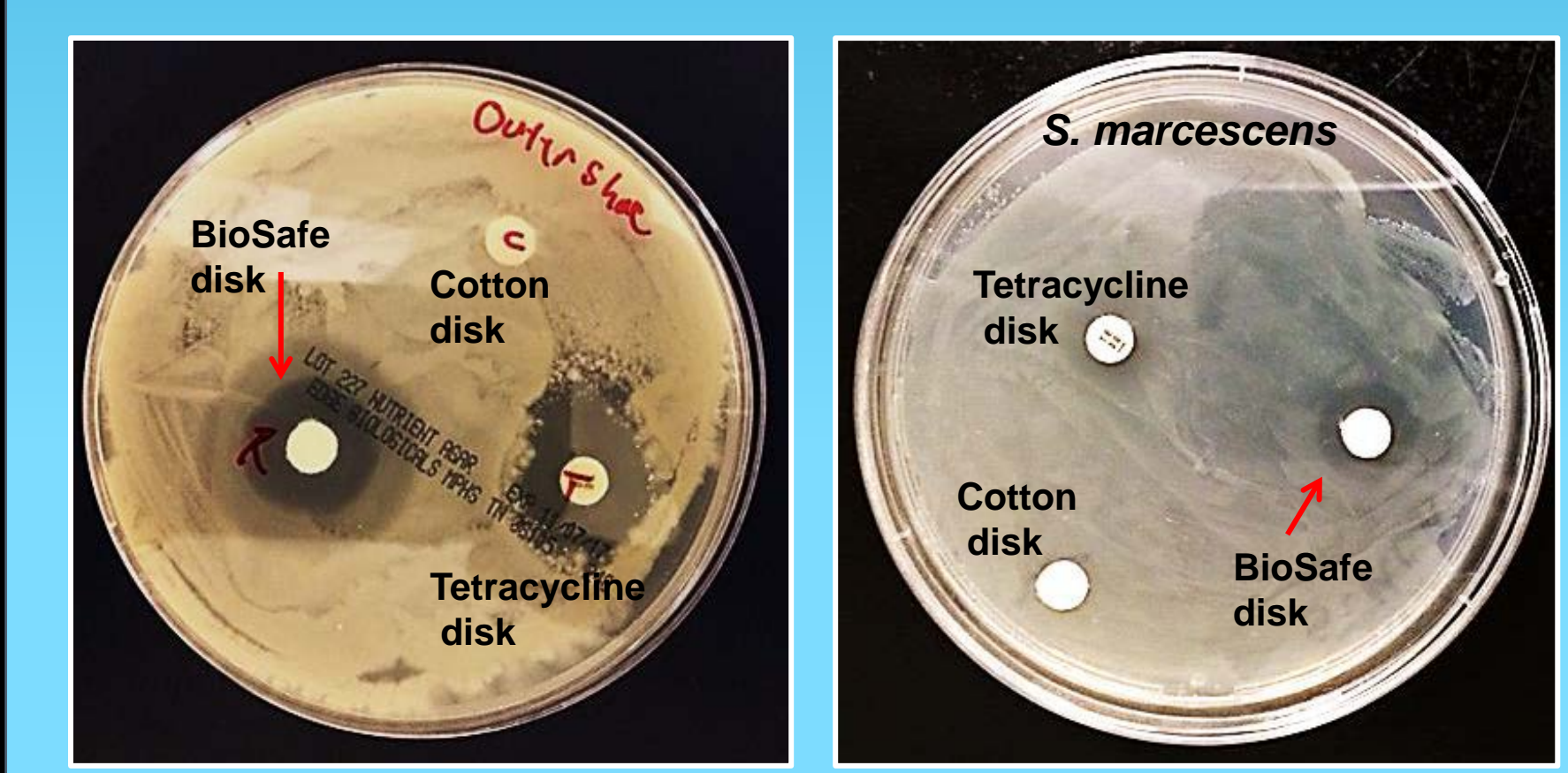
Microbiology

Blood Stained Evidence



a) BioSafe, b) Cotton, c) Control (broth)

- Swab heads placed into 2ml nutrient broth.
- Incubated at 37°C while shaking overnight.
- No bacterial growth (turbidity) observed in BioSafe samples.



Top: Bacterial culture collected with cotton swab from a shoe (Left) or *Serratia marcescens* (Right) is plated on nutrient agar with test disks.

Bottom: *S. marcescens* culture on DNase test agar with Methyl Green.



S. marcescens is a DNase producing bacteria found throughout the environment. A clear zone of inhibited growth surrounds the disk saturated with the BioSafe preservative, whereas a weak zone or no zone of inhibition surround the tetracycline and cotton disk. This indicates BioSafe Swab inhibits bacterial growth from the shoe and the DNase positive *S. marcescens*.

Results

Degradation Index (DI) and Average Quantification yield (n=5) BioSafe Vs. Cotton Swab

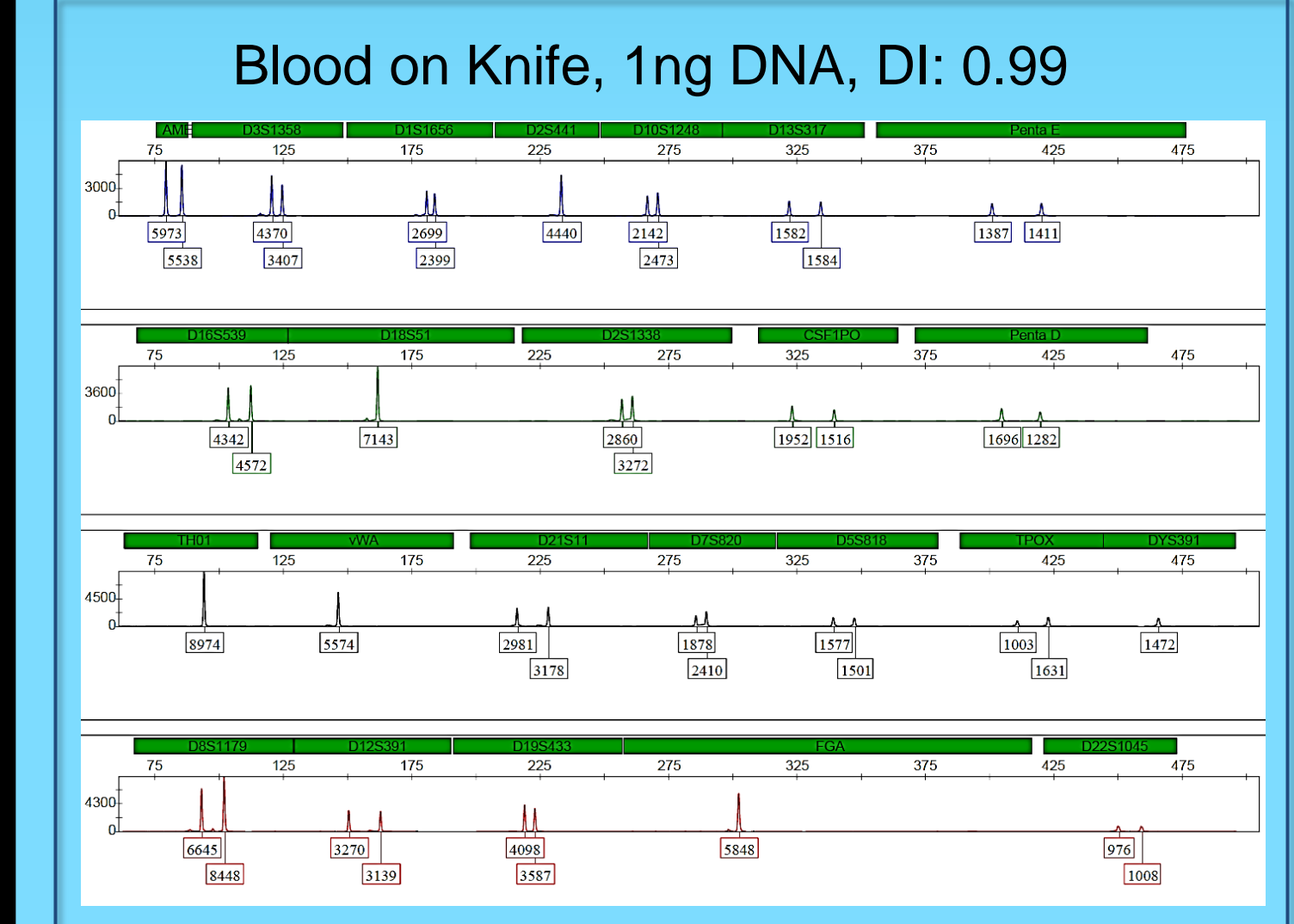
| 65°C Low Humidity | | | | |
|--------------------|----------------|------------------------|-------------------|-----------------------------|
| Evidence Item | Collector Type | Quantification (ng/µl) | Degradation Index | Quant ratio BioSafe: Cotton |
| Wood_Blood | BioSafe Swab | 0.076 | 4.35 | 38.0 |
| | Cotton Swab | 0.002 | Und. | |
| Brick_Blood | BioSafe Swab | 0.027 | 1.9 | 4.5 |
| | Cotton Swab | 0.006 | Und. | |
| Shoe_Blood | BioSafe Swab | 0.257 | 2.2 | 12.2 |
| | Cotton Swab | 0.021 | Und. | |
| Knife_Blood | BioSafe Swab | 0.400 | 1.8 | 1.4 |
| | Cotton Swab | 0.276 | 2.9 | |
| Knife_Saliva | BioSafe Swab | 4.745 | 1.8 | 2.6 |
| | Cotton Swab | 1.811 | 3.7 | |
| Metal_Saliva | BioSafe Swab | 6.746 | 2.1 | 11.3 |
| | Cotton Swab | 0.599 | 5.6 | |
| 22°C High Humidity | | | | |
| Wood_Blood | BioSafe Swab | 0.21 | 1.21 | 35.0 |
| | Cotton Swab | 0.006 | Und. | |
| Brick_Blood | BioSafe Swab | 0.052 | 1.1 | 2.1 |
| | Cotton Swab | 0.025 | Und. | |

Undetermined DI was due to no data available for large autosomal fragments.

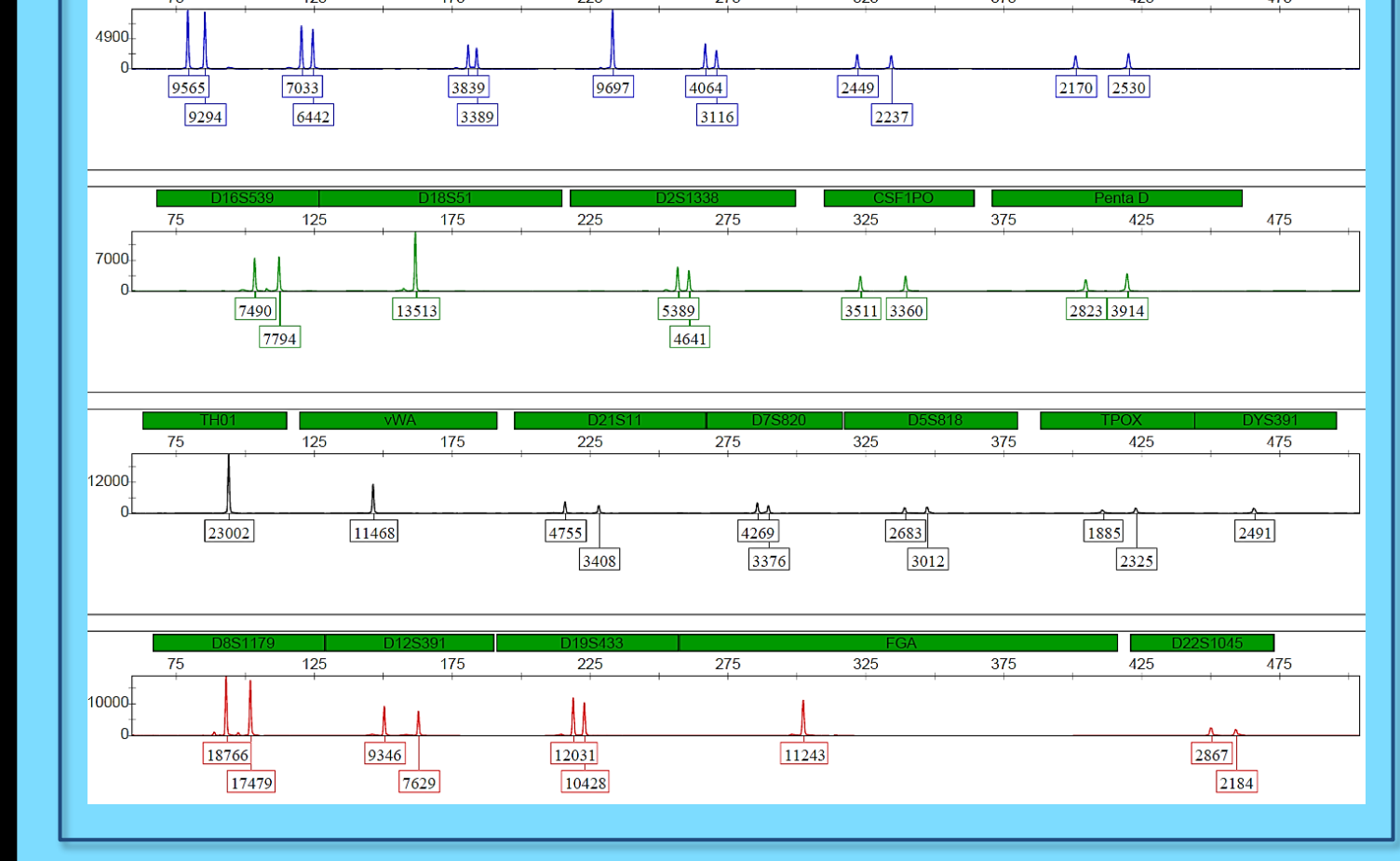
PowerPlex Fusion, 3 year Accelerated Study

Analytical Threshold: 100 RFUs, Stochastic Threshold: 500 RFUs

BioSafe Swab



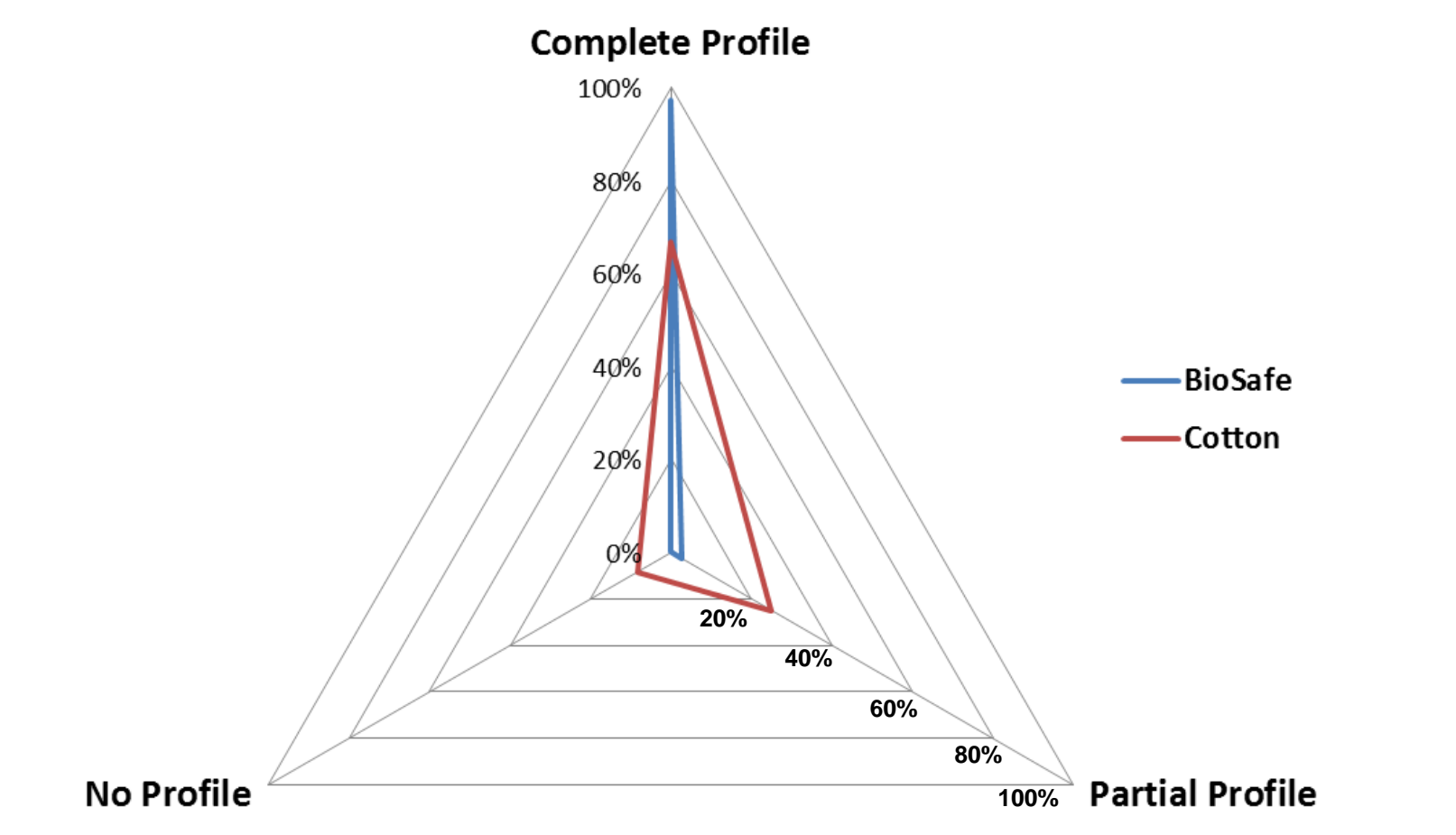
Cotton Swab



Complete Profile Criteria

All alleles must meet operational threshold at all loci.

DNA Profile Quality: BioSafe Swab Vs. Cotton Swab



| | BioSafe Swab (n=36) | Cotton Swab (n=36) |
|------------------|---------------------|--------------------|
| Complete Profile | 97.22% | 66.67% |
| Partial Profile | 2.78% | 25.00% |
| No Profile | 0% | 8.33% |

Conclusion

- The Bode BioSafe Swab inhibits growth of harmful bacteria collected with the evidentiary samples.
- Collecting evidence with the Bode BioSafe Swab resulted in significantly higher quantities of DNA with lower degradation index values.
- Thirty percent more complete profiles (24 loci) were obtained from evidence samples collected with the Bode BioSafe Swab compare to the cotton swab.