COMPARISON OF COPAN FORENSIC COLLECTION KITS TO TRADITIONAL FORENSIC DEVICES FOR MAXIMIZING CRIME SCENE SAMPLE PROCUREMENT

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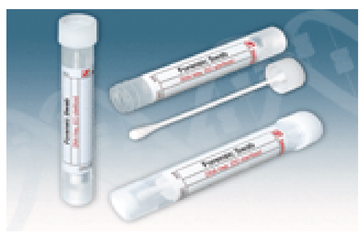
BACKGROUND

Currently, sample procurement from crime scenes is done with collection kits containing traditional swabs made with cotton, polyester, rayon or cellulose. Copan developed forensic (4N6) FLOQSwabs™ (FFS) that are specifically designed in regular, flat, round/rims, or under nails formats to facilitate and maximize crime scene sample collection. FFS are treated to neutralize microbial contaminants, while preserving nucleic acids (NA) integrity and eliminate the need for drying the swab before or during transport or storage.

OBJECTIVE

1. Compare the Copan forensic collection swabs to traditional forensic collection devices, like the Sarstedt forensic swabs and the Whatman® Omniswab for procurement and preservation of nucleic acids for forensic investigation.
2. Validate the FFS ability to preserve nucleic acids in samples with a heavy load of bacterial flora.
3. Validate the quality of nucleic acid for profiling.
4. Validate the ease of use of the special designed FFS for sample collection.

MATERIALS



Sarstedt Forensic swabs

Whatman Omniswabs

Copan (4N6) FLOQSwabs™

Applications:

under nails

Bottle rim or round shapes

deep corners

multipurpose

multipurpose (reinforced handle)

multipurpose (larger head)

flat surfaces

Fig 1:

Fig 2:

Fig 3:

METHODS

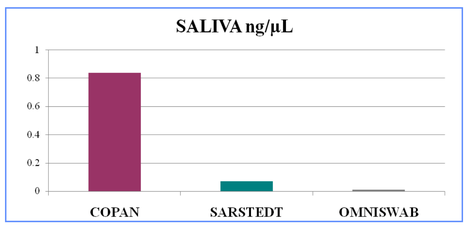
Simulated crime scene traces (n=13) were prepared in the laboratory to reproduce the most common situations where specimens are collected during a crime scene DNA investigation.
The simulated types of traces are listed below:

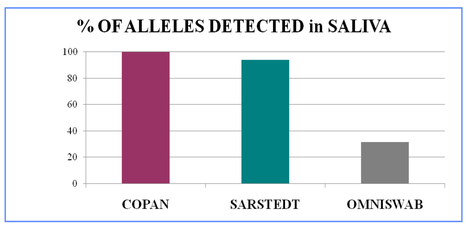
A= blood stains on denim textile
B= blood stains on hard surface (without air drying the swabs after the collection)
C= blood stains on rough surface (back of ceramic tile)
D= blood stain on painted surface (painted ceramic tile)
E= blood on ceramic tile, washed with luminol
F= blood stain on soil (fig 3)
G= blood stain collected in high environmental contaminants condition
H= sweat traces on clothes (T-shirt)
I= saliva traces on bottle neck (fig 1)
L= sweat traces on a handle
M= aggressor's skin traces under victim fingernails (after assault) (fig 2)
N= sweat traces on rope (used to strangle)
O= sweat traces on car's wheel

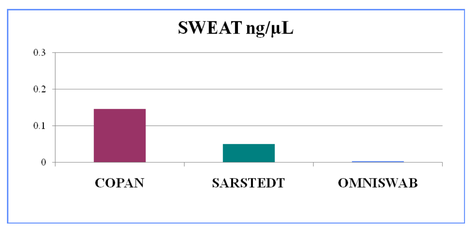
For each trace type, six replicates were prepared. Two of them were used to collect samples with the Copan 4N6 FLOQSwabs™, two with the Sarstedt forensic swabs and two with the Whatman Omniswabs. Each swab was pre-wetted with sterile distilled water.
After collection each swabs was treated as follows:
. The Copan (4N6) FLOQSwab™ was immediately re-inserted into its own tube (without air drying device).
- The Sarstedt swab was immediately re-inserted into its own tube (with air drying system)
- The Whatman Omniswab was broken into 2 ml eppendorf tube and left drying 2 hours before closing the tube.

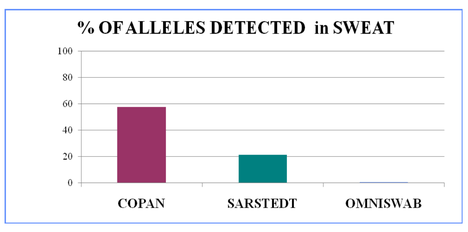
For trace G the swabs were pre-wetted with 50 ul of 1McF microbial contaminants suspension simulating a worse sample collection scenario.
For traces B and G the Whatman Omniswabs were immediately closed into eppendorf tubes without allowing the swabs to dry simulating an incorrect forensic sample collection.
After collection all samples were stored for 10 days at room temperature, then nucleic acids were extracted with the QIamp DNA blood mini elute (Qiagen), quantified by Real Time PCR with Plexor HY kit (Promega) and profiled with NGM PCR amplification kit (Applied Biosystem).

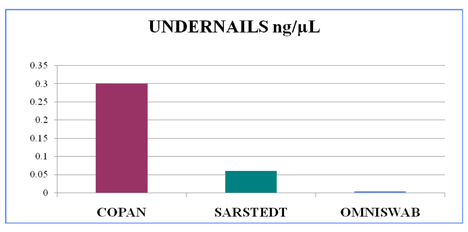
RESULTS

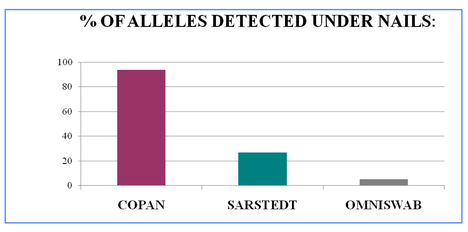


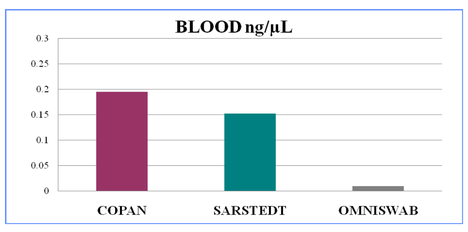


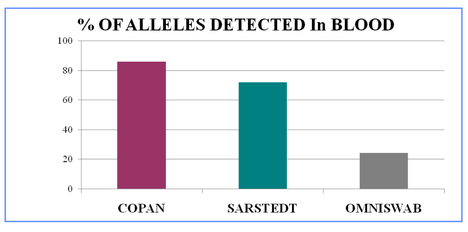


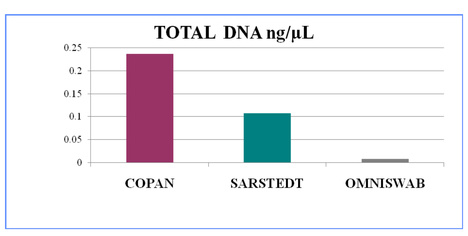


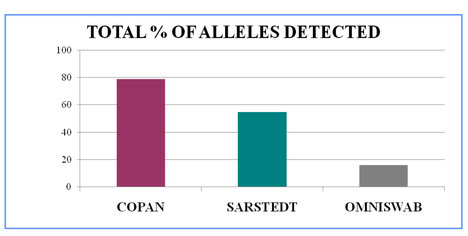












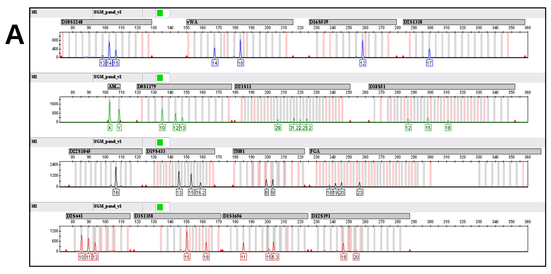
EXAMPLE OF STR ANALYSIS (*TRACE M*):

A= Complete aggressor's profile by 4N6FLOQSWAB

B= partial aggressor's profile by SARSTEDT;

C= partial aggressor' s profile by OMNISWAB.

A



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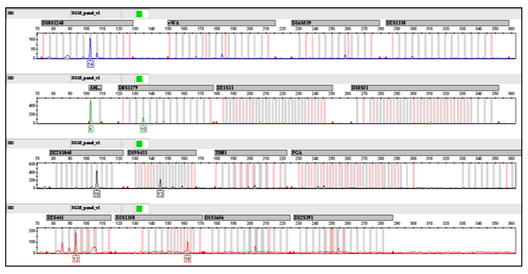
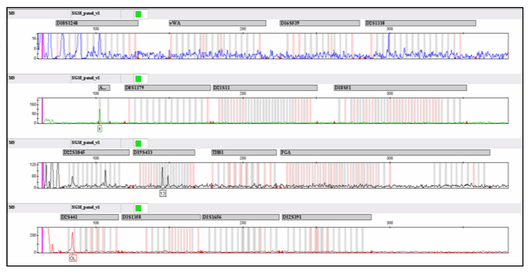


C



DISCUSSION:

- As shown by the graphs, the Copan 4N6 FLOQSwabs™ recovered from blood, saliva, sweat and skin under nail traces 0.20 ng/ul, 0.83 ng/ul, 0.15 ng/ul and of 0.3 ng/ul of human DNA respectively, compared to 0.15 ng/ul, 0.07 ng/ul, 0.05 ng/ul, 0.06 ng/ul of human DNA for the Sarstedt forensic swabs and 0.0097 ng/ul, 0.01ng/ul, 0.0033 ng/ul and 0.0044 ng/ul of human DNA for the Whatman Omniswabs respectively.
- When comparing all the qPCR results, Copan 4N6 FLOQSwabs™ recovered an average of 0.24 ng/ul of human DNA compared to an average of 0.106 ng/ul for the Sarstedt forensic swabs and of 0.0072 ng/ul for the Whatman Omniswabs.
- From the heavily contaminated blood trace (G) Copan 4N6 FLOQSwabs™ detected 0.61 ng/ul versus 0.014 ng/ul for Sarstedt swabs and 0.0 ng/ul for Whatman Omniswabs.
- When analyzing the STR profiles, Copan 4N6 FLOQSwabs™ obtained 78,8% of the total alleles amplified, Sarstedt forensic swabs obtained 54,6% and Whatman Omniswabs obtained 16%.
- From skin traces under fingernails after assaults (M), 100% complete aggressor STR profile was obtained by Copan FFS, contrary to Sarstedt forensic swabs and Whatman Omniswabs.

CONCLUSIONS:

Copan 4N6 FLOQSwabs™ are collecting and preserving 2.2 to 33 times more DNA compared to the Sarstedt and Whatman Omniswabs forensic swabs.
The Copan 4N6 FLOQSwabs™ can be used for sample collection in heavily contaminated environment, even after 10 days storage at room temperature, without the need of drying.
The Copan 4N6 FLOQSwabs™ were easy to handle especially for bottle rim and under nails collection, while Whatman Omniswab and Sartstedt swab often were damaged after collection, especially on hard surfaces.
Future studies using 4N6 FLOQSwabs™ on real crime investigation are in progress.