From Body Fluid Detection to Human Identification: Is mtDNA the missing piece?

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INTRODUCTION

Body Fluid Identification (BFID) is of paramount importance in criminal investigations to characterize potential biological evidence. This step normally precedes DNA profiling. Current methods for BFID are based on chemical, enzymatic and serological methods. The latter is more specific towards the identification of body fluids, as it is based on antigen-antibody reactions binding to a specific protein, unique or almost unique for the body fluid. In this regard, there are serological tests for blood, menstrual blood, semen, and saliva. In spite of the widespread use of these serological tests, there are no studies assessing the impact of environmental conditions on BFID.

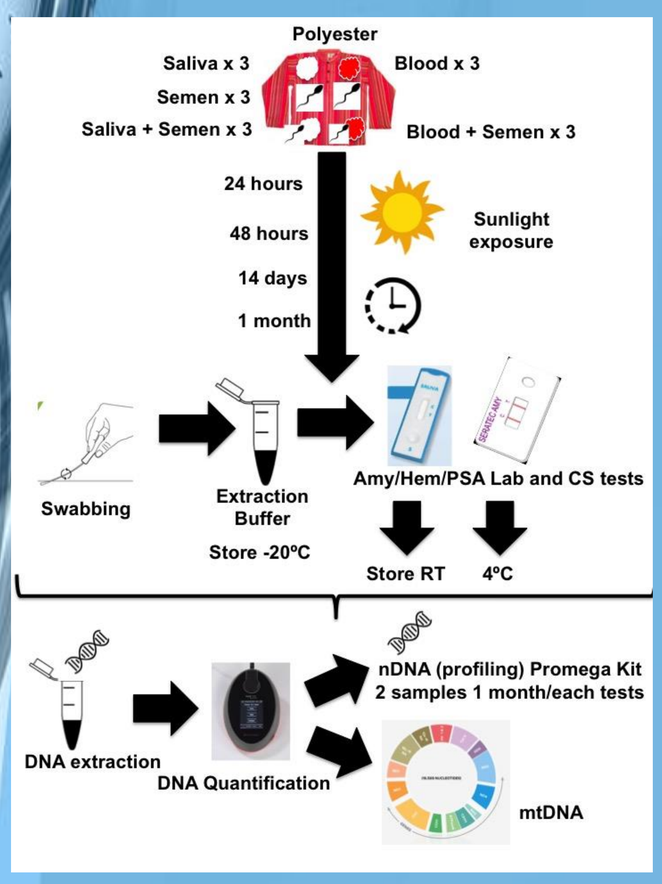
From another part, it is well-known that mitochondrial DNA helps to identify tough DNA substrates, like skeletal remains and hairs. However, few studies have been developed to determine its role on identification from body fluids subjected to harsh environmental conditions.

OBJECTIVES

The present work assessed the effect of tropical weather conditions on body fluid identification and posterior DNA profiling overtime, demonstrating the key role of mtDNA on overcoming the issues of identification.

MATERIALS AND METHODS

This experimental design and procedure was carried out with SERATEC® Immnunochromatographic tests, Lab and Crime Scene versions for blood, semen and saliva.



Average T: 29.3ºC
Average H: 73ºC
UV index: 7
Tropical storms for 19 days

Figure 1. Experimental procedure. DNA was extracted from the extraction buffer applying a modification of the DNeasy Blood and tissue kit (Qiagen), and quantified with Promega PowerQuant System. Statistical analyses were carried out using SPSS (IBM) and applying parametric tests.

RESULTS

***Immunochromatography Tests Results*. It was possible to detect blood and semen up to one month under tropical weather conditions, but not saliva. (Figure 2).**

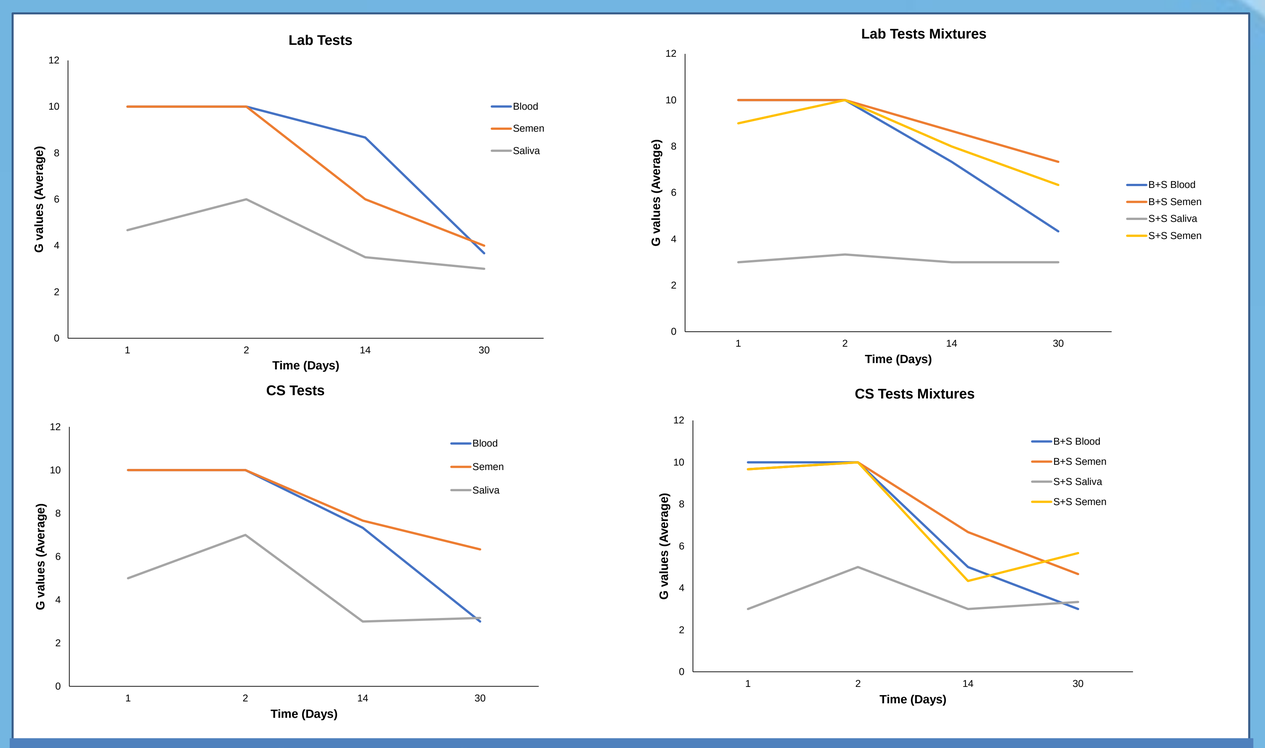


Figure 2. **Average of the results of the LFI tests and mixtures.**

***STR profiles and mtDNA sequencing.* It was possible to obtain full STR profiles from blood up to 14 days, and partial profiles from the other body fluids. Good quality mtDNA was obtained from all samples, being able to assign haplogroups (Figure 3).**

Figure 3. mtDNA sequencing. **It was possible to obtain a good quality mtDNA profile and assign haplogroups in all samples. A) Hypervariable Region 1, HV1F. B) Hypervariable Region 2, HV2F. Bl14d, Blood 14 days; Se14d, Semen 14 days; Sa14d, Saliva 14 days; Bl1m, Blood 1 month; Se1m, Semen 1 month; Sa1m, Saliva 1 month.**

Conclusions

1. This study demonstrated for the first time the possibility of detection of body fluid after exposure to tropical weather conditions over time.
2. Full STRs profiles were able to obtain from blood samples up to 14 days, the rest of the samples retrieved partial or no profiles.
3. It was possible to obtain good quality mtDNA from all samples, assigning the corresponding haplogroups.
4. This study demonstrated the informative value of mtDNA towards human identification.
5. Future research could aim to evaluate this identification in other conditions, also trying to optimize DNA retrieval and improve profile quality.