B63 The Identification and Analysis of Burnt Bloodstains

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After attending this presentation, attendees will learn: (1) which color-based blood screening test is the most effective for the identification of bloodstains exposed to high temperatures; and, (2) which bloodstains are likely to yield informative DNA profiles.

This presentation will impact the forensic science community by improving the overall efficiency with which crime scene investigators and forensic scientists analyze bloodstains from crime scenes that have deliberately been set on fire by criminals in an attempt to destroy evidence.

Various color-based and light-emitting blood screening tests are used to locate and tentatively identify the presence of blood at crime scenes. Typically, only those stains which yield a positive result are collected for subsequent DNA analysis; however, when criminals attempt to destroy evidence using deliberately set fires, for example an arson-homicide case, blood screening tests may not be effective and potentially useful stains may be missed. Furthermore, high temperatures cause significant DNA degradation, thus affecting the quality of the resulting DNA profiles.

In this study, three color-based blood screening tests were compared for their ability to identify bloodstains that were exposed to a range of temperatures that may occur in a structural fire. Polymerase Chain Reaction/ Short Tandem Repeat (PCR/STR) analysis was conducted using the AmpFℓSTR® Profiler Plus® DNA typing kit to determine the impact of heat exposure on the resulting DNA profiles.

The three color-based blood screening reagents used were O-Tolidine (OT), phenolphthalein (KM), and the tetramethylbenzidine-based Hemastix® test strip. To determine the limits of detection of each reagent, bloodstain smears were made on glass and tile surfaces using neat, 1:10, 1:100, or 1:1,000 dilutions of non-human blood. Bloodstains destined for DNA analysis were made on glass using a mixture of non-human blood and human buccal cells. Samples were exposed to temperatures ranging from 60°C to 630°C for 5, 10, or 15 minutes.

All three reagents worked equally well with bloodstains prepared from neat and 1:10 dilutions of blood for all of the test conditions except those which were in direct contact with the alcohol-based flame. Only OT gave positive results with the latter samples. With respect to latent bloodstains prepared from 1:100 and 1:1,000 dilutions of blood, Hemastix® outperformed both OT and KM reagents. None of the reagents gave positive results with latent bloodstains which were in direct contact with the flame.

Not surprisingly, time and temperature were critical factors affecting the degree of DNA degradation and the quality of the resulting DNA profiles. Samples located 15cm above the flame (~160°C) generated complete DNA profiles with all of the exposure times tested. Samples located 10cm above the flame (~250°C) generated full DNA profiles but only for the five-minute exposure time. No profiles were obtained with the 10- and 15-minute exposure times. For samples located 5cm above the flame (~380°C), only those stains exposed for five minutes generated DNA profiles, and only partial genetic information was obtained. Stains which were in direct contact with the flame (~630°C) for five minutes generated extremely limited genetic information.

In summary, the identification of blood is possible in cases where an incendiary fire was used to destroy bloodstain evidence. The three reagents were equally effective for the analysis of visible bloodstains; however, only OT was effective with stains which were in direct contact with the flame. Hemastix® was the best reagent to use with latent bloodstains. These results showed that useful DNA profiles can be obtained from most of the tested bloodstains. The quality of the DNA results depended on the temperature and duration of heat exposure.

Burnt Bloodstains, O-Tolidine, Hemastix®

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