B147 Detection of Semen and Saliva With a Maximum Intensity UV Detection System (Lumatec Superlite 400)

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After attending this presentation, attendees will learn of systematic variation of variables that might affect detection of biological stains on fabric – use of red goggles additional to orange ones – use of UV light possible in daylight if high power machine.

This presentation will impact the forensic community and/or humanity by demonstrating possible change of procedures due to good results in daylight – use of UV lamp at all types of crimes scene, including in daylight.

Introduction: The quality and quantity of detected semen and saliva stains on different types of fabric were tested using a newly developed UV detection system (Lumatec Superlite 400). The system is characterized by a very high output intensity of light so that detection of biological stains even in daylight becomes possible. The machine provides 10 filter positions from 320 to 700 nm with color spectra of white, UVA and blue, violet, turquoise, green, and green-yellow. White (> 400 nm), orange (> 550 nm), and red (>590 nm) goggles were used together with these filters.

Material and Methods: Tested fabric types were 100% polyester — 100% polyamide — 100% cotton — 95% cotton, 5% elastane — 73% cotton, 24% polyamide, 3% elastane — 80% nylon, 20% elastane. As many colors and color combinations of fabric as possible were used, including white and black fabric. 5 and 3 weeks before the analysis, the fabric was stained with either biological stains (saliva, semen) or no stains (control). The clothing was then stored openly in a room under constant conditions (17°C). Some samples were washed at 30°C with "full" detergent (contains oxygen-based bleach), or "soft" detergent (free of bleach). All tests were carried out under blind conditions (observers did not know if a stain was present or not), and either in a dark room, or under constantly illuminated conditions in a regular training room with mostly daylight and some daylight-type artificial light. Biological stains were fresh human and boar semen, and fresh human saliva.

Quantitative Results: (a) Fluorescence intensity was similar in samples that were stored 3 or 5 weeks. (b) After washing, only 25% of the fabric samples with biological stains still produced a detectable fluorescence signal. This was independent of the type of the washing detergent (both "full" and "soft" washing powder led to a 75% reduction of detected samples). (c) To examine differences in the fluorescence of human semen and saliva, the unwashed cloth were compared in 80 combinations of wave length, filters and goggles (10 different filters in the lamp, 3 types of goggles, 5 extra filters (hand-held). Semen and saliva could be detected in 36% (semen) and 41% (saliva) of the combinations, resulting in nearly equal detection rates. (d) Additionally boar and human semen was compared. Even though the amount of pig semen per ejaculation is at least one hundred times increased against men, the fluorescence signal of pig semen is clearly weaker than that of human semen. (e) To check the influence of the color of the fabric on the fluorescence signal, the clothing was grouped into three groups: "bright," (white, bright blue, pink), "medium" (blue, red, green, orange, yellow) and "dark." Stains on "medium" and "bright" color types of fabric could be detected in 34%-38% of the cases with a very low rate of weak signals ("medium" fabric colors: 32% intensive detection signal, 2% weak detection signal; "bright" fabric colors: 31% intensive, 3% weak). The detection rate on "dark" fabric (black, brown, dark blue) was nearly the same (38%) but a higher rate (15%) produced only a weak signal. Thus, dark colors, especially pure black, reduce the chance of detection of biological traces, even when using a high-power UV source.

Further Observations: (a) Comparison of two cotton samples in three "medium" and "dark" colors (one jeans skirt (blue) and one black and white top) showed that semen on black cotton could be visualized with the 400-700 nm filter with all goggles, whilst the same filter did not work with bright colors. This contrasts the daily experience as well as other test results. (b) Samples under day/room light conditions with filter wavelengths of 320-500 nm showed only in one third of the cases a weaker fluorescence signal than in darkness. In most cases, the signal was as strong as in darkness. Therefore, the Superlite 400 can be used in the laboratory as well as at crime scenes. (c) Using red goggles designed for ninhydrin applications might be a promising addition to the use of orange goggles for biological stains. At wavelengths between 320 and 570 nm — especially at 550 nm — the red goggles allowed detection of fluorescence signals on polyester and cotton that were not visualized by the orange goggles (61% of observations (n=11); exception: pure black fabric).

UV Light, Semen Stains, Saliva Stains

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