Streszczenie w języku angielskim

When inspecting the crime scene, tools or victims, blood traces may not be visible. Nevertheless, it is possible to unveil such traces both with the use of chemical methods and also with the use of an alternative light source (ALS). Both methods use the properties of the protein hemoglobin. The use of ALS makes use of the presence of strong absorption bands for the wavelength of light corresponding to ultraviolet radiation, the visible light spectrum and also infrared radiation. Chemical methods such as Bluestar Forensic base on of the catalytic properties of the haem to induce a coloured reaction of the substrates, even on washed stains. The above-mentioned methods are used when it is necessary to visualize biological traces and to show the most appropriate places for their collection, in order to use them later for possible identification of an individual.

The aim of the study was to assess:

- The possibility of using ALS to distinguish blood traces from simulated bloodstains on different surfaces.
- The sensitivity of the bloodstain visualization method using an alternative light source and Bluestar Forensic
- The possibility of visualization of bloodstains subjected to various conditions of the external environment.
- The possibility of genetic identification of human blood traces revealed by ALS and Blue Star Forensic.

Material and methods

The material consisted of venous blood collected from healthy volunteers and venous blood collected during forensic post-mortem examinations. The collected material was applied to various surfaces: corroded metal, wood, coloured cotton fabric, biological material - coloured birch leaves, garden soil, a fragment of an animal bone (porcine shoulder). Mock stains made from tomato juice, red paint were applied to the same substrates.

ALS emitting light wavelengths of 555, 535, 515, 455, 415, 300-400 nm, white light and CSS spectrum was used to reveal the traces. Simultaneously yellow, orange, and red cut-off filters were used during the illumination. The revealed traces of blood were treated with selected physical, chemical and biological factors: water with soap, steam and saprophytic fungi leading to the development of mold (*Penicillium* and *Aspergillus* spp.). The traces treated this way were revealed again with the use of ALS and Bluestar Forensic. All experimental traces were

observed for 56 days – the studies were repeated every 7 days. After the trace was revealed, samples were taken for genetic testing.

In the identification study, the isolation of biological material was performed using the Bio-Trace DNA Purification Kit, determination of DNA concentration using the Quantifiler kit and the 7500 Real Time PCR System (Applied Biosystems) apparatus, DNA amplification with the use of NGM PCR nuclear DNA polymorphism identification kits Amplification Kit analysis of genetic profiles using the 3130 Genetic Analyzer (Applied Biosystems).

The consent for the research was granted by the Bioethics Committee of the Medical University of Bialystok - consent no.R-I-002/479/2018

Results

1. The use of the alternative light source facilitates the disclosure of blood stains and the discrimination of simulated bloodstains by using the appropriate combination of wavelength and the cut-off filter. ALS does not allow to differentiate the blood trace coming from a living or dead person.

2. The use of an alternative light source ALS enables the visualization of washed out bloodstains on a variety of contrasting surfaces, using the appropriate wavelength of light and cut-off filters. Bluestar Forensic enables the visualization of blurred and highly diluted spots. The structural features of the surface affect their appearance in daylight and in alternative light. They also affect the intensity of fluorescence and absorption of the light wave, which is decisive in the process of their disclosure and identification.

3. Alternative light source can be used as a quick and sensitive method for initial recognition and selecting for further identification tests, even faint traces of human blood subjected to washing out. Bluestar Forensic is more effective in visualizing diluted blood traces (up to 1: 100,000)

4. External factors affecting the substrate and the blood stain significantly limit the possibilities of visualization and genetic identification. These difficulties first concern the D2S1338, D16S639, D18S51, FGA, D12S391 alleles of the NGM PCR Amplification Kit. A consistent sequence of allele "dropouts" was not observed.

Disclosure of washed out and diluted blood traces enables full genetic identification of the material in the case of concentration levels above 0.1 ng and dilution of the material less than 1: 20,000.