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Body Fluids Identification by Raman Spectroscopy and Matrix-Assisted Laser Desorption/Ionization Time-of-Flight Mass Spectrometry

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Abstract : The identification of human body fluids during forensic investigations is a critical step to determine key details, and present strong evidence to testify criminal in a case. With the popularity of DNA and improved detection technology, the potential question must be revolved that whether the suspect's DNA derived from saliva or semen, menstrual or peripheral blood, how to identify the red substance or aged blood traces on the spot is blood; How to determine who contribute the right one in mixed stains. In recent years, molecular approaches have been developing increasingly on mRNA, miRNA, DNA methylation and microbial markers, but appear expensive, time-consuming, and destructive disadvantages. Physicochemical methods are utilized frequently such us scanning electron microscopy/energy spectroscopy and X-ray fluorescence and so on, but results only showing one or two characteristics of body fluid itself and that out of working in unknown or mixed body fluid stains. This paper focuses on using chemistry methods Raman spectroscopy and matrix-assisted laser desorption/ionization time-of-flight mass spectrometry to discriminate species of peripheral blood, menstrual blood, semen, saliva, vaginal secretions, urine or sweat. Firstly, non-destructive, confirmatory, convenient and fast Raman spectroscopy method combined with more accurate matrix-assisted laser desorption/ionization time-of-flight mass spectrometry method can totally distinguish one from other body fluids. Secondly, 11 spectral signatures and specific metabolic molecules have been obtained by analysis results after 70 samples detected. Thirdly, Raman results showed peripheral and menstrual blood, saliva and vaginal have highly similar spectroscopic features. Advanced statistical analysis of the multiple Raman spectra must be requested to classify one to another. On the other hand, it seems that the lactic acid can differentiate peripheral and menstrual blood detected by matrix-assisted laser desorption/ionization time-of-flight mass spectrometry, but that is not a specific metabolic molecule, more sensitivity ones will be analyzed in a forward study. These results demonstrate the great potential of the developed chemistry methods for forensic applications, although more work is needed for method validation.

Keywords : body fluids, identification, Raman spectroscopy, matrix-assisted laser desorption/ionization time-of-flight mass spectrometry
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