B118 The Limits of Detection (LODs) of Surface-Enhanced Raman Spectroscopy (SERS) -Active Swabs Used to Screen for Human Bodily Fluids (HBFs)

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After attending this presentation, attendees will better understand the sensitivity associated with a novel technique for the screening of HBFs for confirmatory identification of semen, saliva, and their mixtures.

This presentation will impact the forensic science community by providing the LODs of a technique that enables rapid, highly sensitive, non-destructive identification of semen, saliva, and their mixtures. The sufficient concentration of each HBF and mixture analyzed that are needed to produce an analytical signal that can be reliably discriminated from the signal produced without the pure HBFs or mixtures will be determined. The methodology will ultimately be extended to acquire the LODs of other pure HBFs (blood and vaginal fluid) and other mixtures.

The screening of HBFs is routinely conducted in crime laboratories prior to DNA analysis. First, a presumptive test is conducted to determine whether a specific bodily fluid can be present, followed by a confirmatory test, which establishes the identity of the material; however, the existing methods are prone to false positives and false negatives and therefore lack sensitivity and specificity. Furthermore, these tests require extensive sample pre-treatment, expensive chemicals, and are time consuming and destructive for the sample.

Raman spectroscopy is an analytical technique that provides information about molecular vibrations that can be used for sample identification and quantitation. The suitability of Raman spectroscopy for the analysis of bodily fluids has been reported as this technique allows for the rapid, highly selective, and non-destructive analysis of the samples.[1] Raman may also offer the possibility of performing one type of measurement for all HBFs, while also preserving the DNA evidence contained in such samples; however, the high sensitivity required for forensic samples may not be obtainable with Raman spectroscopy alone. Therefore, SERS may be more suitable for the analysis of HBFs as it enables the enhancement of analyte signals by several orders of magnitude. This increases the sensitivity of the Raman and therefore its ability to detect small amounts, dilute samples, and mixtures, which can be found at a crime scene.

Silver nanoparticles were attached to nylon Copan 4N6FLOQSwabs™ using the hydrogen reduction method.[2] Seminal fluid from was obtained from Lee Biosolutions™, Inc. Mixtures were prepared with different semen/saliva ratios. A range of concentrations of the semen and saliva, as well as their mixtures, were produced to measure their LODs. Different swabbing techniques were explored and Raman data of analyte adhered to the SERS-active swabs was measured using a 632.8nm laser excitation. Distinctive SERS bands of semen and saliva were used to identify their contributions in the mixtures. Based on the signal-to-noise approach, the LODs were then determined. The measured signals from the bodily fluids of known low concentrations were compared with those from blank samples using a signal-to-noise ratio of three. The minimum concentration at which the bodily fluids and mixtures could be reliably detected was then established.

Reference(s):

1. Kelly Virkler and Igor V. Lednev. Raman spectroscopy offers great potential for the nondestructive confirmatory identification of body fluids. *Forensic Sci Int*. 181 (2008): e1-e5.

2. David D. Evanoff and George Chumanov. Size-controlled synthesis of nanoparticles. 1. “Silver-only” Aqueous Suspensions via Hydrogen Reduction. *J Phys Chem B*. 37 (2004): 13948-13956.

Serology, SERS, Limits of Detection