A176 Analysis of Tobacco Exposure in Human Hair Using Total Vaporization-Solid Phase Microextraction (TV-SPME) Gas Chromatography/Mass Spectrometry (GC/MS)

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After attending this presentation, attendees will understand a new sampling technique for the analysis of volatile components using Total Vaporization-Solid Phase Microextraction (TV-SPME). Specifically, this presentation will describe the analysis of tobacco exposure in human hair by TV-SPME.

This presentation will impact the forensic science community by describing, in detail, the theory behind TV-SPME and its applicability to volatile analytes in artifacts of forensic interest.

SPME is a sampling technique in which volatile components are absorbed onto a fiber and then subsequently desorbed into an analytical instrument such as a liquid or gas chromatograph. The thermodynamics of SPME are largely dependent on analyte partitioning between the liquid sample, the headspace above the sample, and the SPME fiber. A new technique has been proposed whereby a liquid sample is vaporized. By completely vaporizing the sample, the partitioning between the sample and the headspace is eliminated, thus simplifying the thermodynamic equilibrium. This presentation will discuss the theory and application of TV-SPME. Additionally, there are many parameters that must be optimized in developing a SPME method, including SPME fiber chemistry, incubation temperature, incubation time, extraction time, desorption time, and sample volume. Using a statistical experimental design is the best way to determine the optimal parameters without performing every possible parameter combination, or a "vary one parameter at a time" method. A statistical experimental design also allows for interactions between parameters to be realized; for example, how sample volume and incubation temperature interact with one another. A response surface methodology experimental design was used to optimize the parameters of the TV-SPME technique.

Current methods of determining tobacco exposure from hair require large sample sizes and extensive extraction procedures. The methods being developed require only 10mg of hair and the extraction is conducted by digesting the hair in sodium hydroxide followed by liquid-liquid extraction with chloroform. Nicotine and its metabolite (cotinine) are quantitated using TV-SPME coupled to GC/MS. Typical protocols for analyzing tobacco exposure from human hair use liquid injections with GC or LC. In GC, injection volumes are usually limited to several microliters. This can be problematic, especially when sample size is limited, because the concentration of nicotine and cotinine in hair is very low (<50ng/mg hair). Using total vaporization SPME, lower analyte concentrations can be easily detected because the sample volume is much larger (>100µL). This greatly increases the analyte amount injected onto a GC column, thereby making total vaporization SPME a very sensitive technique. Tobacco exposure will be determined by comparing nicotine and cotinine concentrations from a hair digest, and classifying people as tobacco users, non-users, and ex-tobacco users. In addition, it would be beneficial to classify tobacco users as smokers and smokeless tobacco users. This has been accomplished using urine, but there are no reports using hair.

Solid Phase Microextraction, Human Hair, Tobacco Exposure

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