B161 Odorant Measurements and New Materials for Canine Training

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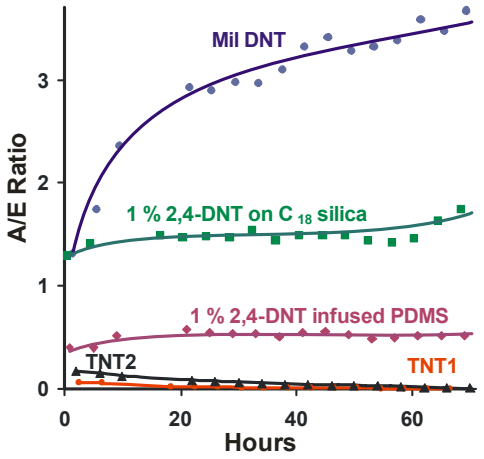
The goal of this presentation is to bring scientific rigor to canine training through measurements and training aid materials.

This presentation will impact the forensic science community by explaining how training aid materials were devised that provide the scent profile of real explosives and how this may improve court acceptance of forensic working dog evidence.

Canines achieve very high sensitivity for detecting military and improvised explosives using the volatile signatures of these materials. Solid-Phase Microextraction (SPME) coupled with techniques such as Gas Chromatography/Mass Spectrometry (GC/MS) is typically used for analysis of such vapor profiles; however, SPME/GC/MS measurements suffer from irreproducibility as a result of fiber-to-fiber absorptive differences as well as drift in the absorptive capacity and MS detector response. This limits the potential to characterize equitably the vapor profile of different samples or monitor the vapor-time profile of a given sample. The National Institute of Standards and Technology (NIST) has introduced an approach that permits the reliable characterization of the vapor profile of a sample relative to the saturated headspace of the target analyte. To achieve reproducibility, the SPME fiber will first sample from an "internal standard" and then sample the test or calibrant sample. This approach, Solid-Phase Microextraction/Externally Sampled Internal Standard (SPME/ESIS), improves the reproducibility of SPME/GC/MS by more than an order of magnitude.[1] SPME/ESIS has been applied determine the vapor-time profile of a number of explosives, volatile components in explosives formulations, and as a screening tool for the development of training aid materials for canine detection.[2]



A particularly promising approach to training aid fabrication is "infusing" the volatile components of explosives into a polymer matrix (Polydimethylsiloxane (PDMS)). This approach provides a reliable vapor release and renders explosives inert. Infusion and vapor release were tested for Triacetone Triperoxide (TATP) (an improvised explosive), 2-ethylhexanol (a plastic explosives odorant), and 2,4-dinitrotoluene (DNT) (the volatile odorant in TNT). The results for a simulated training aid for DNT is shown in the figure. After a short induction period, constant release of the DNT from the infused PDMS (pink trace) was demonstrated over 70 hours using the SPME/ESIS technique by the consistency of the A/E ratio.

Infusing the odors of TATP, Composition C-4, and Semtex into PDMS is also providing promising results for canine detection. Bomb dogs trained on these explosives alert 80% to 100% of the time when presented with the infused PDMS simulants.

The design of the training aid container using a novel simulated canine nose has also been evaluated. This anatomically-correct nose "sniffs" with the known velocities of large dogs. A means of capturing and analyzing the collected odorant is also incorporated into the system, permitting a quantitative measure of the performance of the training aid design.

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References:

1. MacCrehan, W., Moore, S., Schantz, M. "Evaluating Headspace Component Vapor-Time Profiles Using Solid-phase Microextraction (SPME) with External Sampling of an Internal Standard (ESIS)" *Anal. Chem. 2011*, 83, 8560 – 8565.
2. MacCrehan, W., Moore, S., Schantz, M. "Reproducible Vapor-Time Profiles using Solid-Phase Microextracton with an Externally-Sampled Internal Standard (SPME-ESIS)" *J. Chromatog. A 2012*, 1244, 28-36.

Canine Detection, Training Aid, Quantitative Odor Measurement