B60 A Preliminary Characterization of Sexual Assault Lubricants: A Comparison Between Direct Analysis in Real-Time Time-Of-Flight/Mass Spectrometry (DART®-TOF/MS), Gas Chromatography/Mass Spectrometry (GC/MS), and Fourier Transform Infrared (FTIR) Spectrometry

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After attending this presentation, attendees will understand the utility of the classification of lubricants as a novel technique for the analysis of sexual assault trace evidence using DART®-TOF/MS, in comparison to GC/MS and FTIR spectrometry.

This presentation will impact the forensic science community by aiding in the classification of unknown sexual lubricant samples based on components that are indicative of a type or class, thus providing investigative leads and innovative techniques in the analysis of trace evidence.

Unfortunately, sexual assaults are a reality in today's society. Due to the increasing use of condoms, there may be a reduced potential of finding DNA evidence in sexual assault cases. This requires a novel approach to the analysis of other trace evidence. The classification and characterization of lubricants is a relatively new approach in providing a method to analyze unknown trace evidence in such instances. In this study, approximately 20 samples from different sexual lubricant manufacturing types were tested, including water-based, silicone-based, oil-based, organic/edible, and others, which may include Personal Hygiene Products (PHPs) and lotions. The tested lubricant samples may be sub-classified as regular, sensation, flavored, spermicidal, and anesthetic based on additives in the formulation designed to impart a specific functionality (i.e., lidocaine or capsaicin).

This research sought to analyze lubricants and PHPs using DART®-TOF/MS, GC/MS, and FTIR methods that could aid in the identification of components in sexual lubricants. The goal of this study was to create a classification and characterization scheme to provide investigative leads from unknown lubricant samples. Neat lubricants as well as extracts were analyzed in both positive and negative ionization modes using DART®-TOF/MS in replicates of five. Neat lubricants and extracts (i.e., chloroform and hexane) were also analyzed via FTIR in triplicate. The neat lubricant samples were not analyzed directly by GC/MS; in turn, only the extracts were analyzed in triplicate. This information provided the necessary data to identify unique markers that define each individual lubricant class. Multivariate statistical techniques were used to create a classification scheme for the lubricants from the DART®-TOF/MS, GC/MS, and FTIR results. The outcomes of the classification schemes are expected to separate the different manufacturing types into different groups, as well as sub-classes within each manufacturing type. Unknowns were classified based on each Linear Discriminant Analysis (LDA) model from each instrument and were used to determine which instrument provides the best classification.

To provide a real-world example, cotton swabs from sexual assault kits were utilized as the collection media. Small amounts of lubricant and PHP samples were deposited onto the cotton swab and allowed to sit for one hour. Subsequently, a portion of the cotton swab was extracted in a 1:1 dichloromethane and methanol mixture for DART®-TOF/MS and GC/MS analysis. The remaining portion was extracted with either chloroform or hexane for FTIR. The extract results were compared to the classification scheme developed from the neat samples to determine how accurate the classification of real-world samples would be. The classification scheme developed from this preliminary study may ultimately enable future identification of questioned lubricant samples collected from crime scenes.

Sexual Lubricants, DART®-TOF/MS, Characterization