B32 The Identification and Quantification of Sexual Lubricant Degradation Pathways From Exposure to the Vaginal Bacterial Environment

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After attending this presentation, attendees will understand how the vaginal bacterial environment can degrade sexual lubricants and change their chemical composition prior to laboratory analysis. The goal of this presentation is to educate the forensic trace evidence community on how lubricants collected can differ from the known source over time based on bacteria and how to address that issue in casework.

This presentation will impact the forensic science community by bridging the gap in knowledge regarding the characterization of residual lubricant degradation and by describing how degradation from microbial exposure affects the identification and comparison of condoms and sexual lubricants for forensic and judicial purposes.

Due to the use of DNA analysis for identification in criminal acts, an increasing number of offenders are using condoms to mask their identity from law enforcement. During the act of coitus, lubricant found on the condom can be transferred to the victim. In forensic lubricant analysis, the major components of lubricants are used as indicators of the presence of sexual lubricants. The major components of lubricants can include Polydimethylsiloxane (PDMS), Polyethylene Glycol (PEG), and Nonoxynol-9 (N-9). These normal alkane and aromatic compounds can be degraded, into smaller components, by the bacteria that is natural to the vaginal cavity.[1,2]

In order to maintain a healthy environment, the female genital tract will maintain stable conditions using bacteria with the ability to produce lactic acid. This lactic acid-producing bacteria, which includes members of the *Lactobacillus, Pseudomonas*, or the *Megasphaera* species, keep the pH at the desired levels and keeps out any disease-causing microorganisms. The lactic acid production from these bacteria can use residual lubricants that remain in or near the vagina as a possible energy source, thus leading to sample degradation, which can change the original chemical composition. The degradation caused by microbial exposure makes it necessary to understand how the microbes degrade the condom lubricant components and how the degradation changes the overall chemical profile of the lubricant.

The degradation of a common lubricant, PEG, was studied using a common vaginal microbe, *Pseudomonas putida* (*P. putida*). PEG was inoculated with *P. putida* and the resulting samples were collected over a four-day period. Chemical degradation was determined with the use of a Direct Analysis in Real Time-Time-Of-Flight/Mass Spectrometer (DART®-TOF/MS). The DART®-TOF/MS was selected for this analysis primarily based on the direct MS analysis. This instrument can analyze individual components in the sample simultaneously with high resolution and accurate mass measurements, which provides a high degree of discrimination between samples. Coupled with the short run time and minimal sample preparation of the DART®-TOF/MS, the instrument is ideal for analysis of degraded and non-degraded lubricant samples.

Preliminary data suggest the *P. putida* bacteria will degrade the lubricant component over a period of three to four days before the lubricant chemical profile is no longer detectable. Based on this information it is necessary to determine how other common bacteria affect PEG, PDMS, or the condom lubricant as a whole. This information can provide the forensic science and sexual assault investigation communities with a new analytical timeline for vaginal samples collected after a sexual assault.

Reference(s):

1. Kirkbride K.P., Yap S.M., Andrews S., Pigou P.E., Klass G., Dinan A.C., Peddie F.L. Microbial Degradation of Petroleum Hydrocarbons: Implications for Arson Residue Analysis. *Journal of Forensic Sciences* 1992, 37 (6), 1585-1599.
2. Hutches K. Microbial degradation of ignitable liquids on building materials. *Forensic Sci Int* 2013, 232 (1-3), e38-e41.

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