Y19 A Longitudinal Study of the Effects of Storage Conditions on DNA Recovery From Condoms

Claire J. Loretta, Pittsburgh, PA 15203; Lisa R. Ludvico, PhD, Duquesne University, Pittsburgh, PA 15282; Pamela L. Marshall, PhD, Duquesne University, Pittsburgh, PA 15282; Stephanie J. Wetzel, PhD, Duquesne University, Pittsburgh, PA 15282*

Learning Overview: After attending this presentation, attendees will understand the relationship between storage duration, storage temperature, and condom brand on the quantity and quality of male DNA recovered from condoms.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing a simple, yet essential, proof-of-concept that has yet to be investigated—the impact of condoms on DNA degradation. This presentation will serve as the framework for future studies so that the individual variables in question can be studied in greater detail.

With increased public awareness of the value of DNA in criminal investigations, the number of sexual assaults involving condom use has also increased. Maximizing the utility of evidence—both biologically and chemically—has presented a variety of challenges to an assortment of forensic professionals, such as crime scene investigators, detectives, and laboratory technicians.

Typically, the most crucial evidence in a sexual assault investigation is collected from the survivor during a medical forensic examination in the form of a Sexual Assault Kit (SAK). Unfortunately, the backlog of untested SAKs in the United States is immense. However, condoms are not collected with SAKs and therefore are separately submitted for forensic testing. Because condoms circumvent the SAK backlog, they are often processed much more rapidly, creating a huge advantage for investigators that may allow them to identify a perpetrator without SAK evidence.

While the consequences of DNA degradation are well established across a wide variety of conditions, literature pertaining to the influence of condoms on DNA degradation is practically non-existent. Of the literature concerning condoms, research is primarily focused on the detection and identification of chemical compounds found within condom lubricants. The majority of these efforts contribute to a broader objective—to establish a universal classification scheme and to construct a database of sexual lubricant profiles. Though sexual lubricant analysis is an important and rapidly growing field of trace evidence, it does not exhibit the same discriminatory power and identification capacity that DNA does.

The objective of this study was to investigate the effects of condoms on DNA degradation; it established a fundamental understanding of the relationship between DNA, condoms, and storage conditions.

Both DNA quantity and quality were measured across three variables: (1) time, (2) temperature, and (3) condom brand. Neat semen from one male was aliquoted into condoms from three manufacturers (Trojan®, Durex®, and Sustain®), followed by sample storage at three different temperatures (25°C, 4°C, and -20°C). The total storage duration was one year (52 weeks) with sample analysis at four separate intervals: t_0=0 weeks, t_1=16 weeks, t_2=32 weeks, and t_3=52 weeks.

All samples were extracted using the DNA IQ™ System and quantified via a QuantStudio™ 5 Real-Time PCR System using the Quantifiler® Human DNA Quantification Kit. The sample extracts were then amplified with the GlobalFiler™ PCR Amplification Kit via a GeneAmp® PCR System 9700; all samples underwent capillary electrophoresis in a 3130 Genetic Analyzer and were analyzed with GeneMarker® HID software. In addition to DNA analysis, microscope slide smears were prepared and stained with Christmas Tree stain to evaluate sperm morphology. Finally, the primary chemical compounds of each condom lubricant were identified using quadrupole Time-Of-Flight Liquid Chromatography/Mass Spectrometry(qTOF-LC/MS) performed on an Agilent® 6530 qTOF-LC/MS.

The quantities of DNA at t_1 and t_2 were relatively consistent. All samples stored at 25°C had DNA concentrations of 0.01ng/µL or less, while samples stored at 4°C and -20°C had concentrations between 2.35–3.78ng/µL at t_1 and 2.25–8.56ng/µL at t_2. No significant differences in DNA concentrations were observed between the three condom brands or between the storage temperatures of 4°C and -20°C.

By investigating the progression of DNA degradation within condoms, consistent methods for optimal condom preservation can be employed. Furthermore, supplementing a database of the chemical profiles of sexual lubricants with biological counterparts would considerably increase the value and versatility of such a database.

Condoms, DNA Degradation, Storage