in Sexual Assault Kits Over One Year

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Introduction

There is a large backlog of sexual assault kit testing in the United States leading to lengthy storage times[1]. Proper storage conditions are required to maintain a high quantity of DNA to obtain reliable results[2]. DNA may degrade in storage due to a variety of reasons such as temperature and humidity[3]. Minimizing the humidity and maintaining the correct temperature is crucial to obtain reliable results from sexual assault samples[4]. Storage with a desiccant may help reduce the humidity, especially if a climate-controlled room is not obtainable in the lab[5]. The current Pennsylvania State Police Sexual Assault Collection Kit does not contain a desiccant to account for the humid conditions of a lab and requires a drying step for the swabs before storage which could expose the swabs to contamination and degradation.

Desiccants

A desiccant can be used in storage to keep the evidentiary sample dry. The desiccant can lower the risk of contamination in the drying process and limit the degradation of the sample by reducing humidity. The desiccant used is a solid desiccant made of silica beads. It works by absorbing the moisture from the air that flows through it, releasing dry air into the environment[5].

Figure 1: An example of a Silica Bead Desiccant

Materials and Methods Design

Collection

- Self-collection from female participants
- Semen was purchased (BioIVT™)
- Pennsylvania State Police Sexual Assault Kit (Sirchie®)
- Gentueri™ Sexual Assault Kit

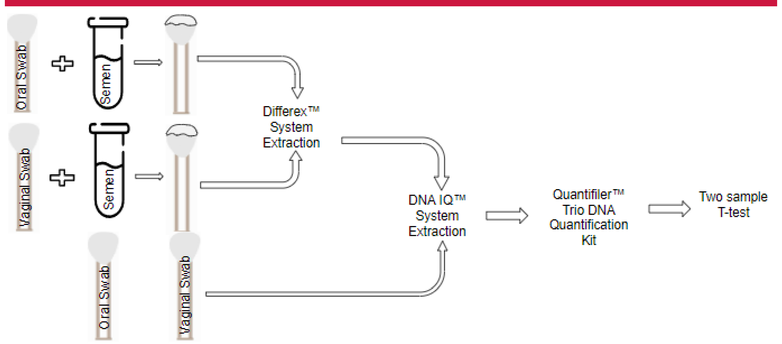
Preparation

50 µL of semen was deposited on one oral and one vaginal swab for each kit from each participant. One oral and one vaginal swab was stored without semen from each kit for each participant.

Storage

25°C and 4°C and humidity was controlled

Method of DNA Analysis



Results

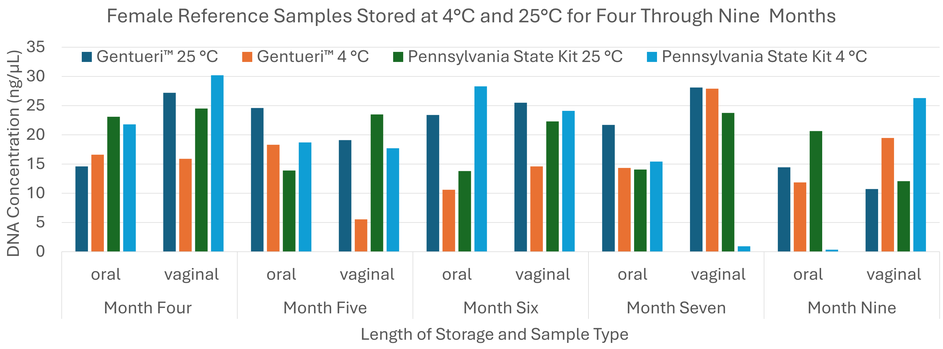


Figure 2: Total DNA concentrations from self-collected oral and vaginal swabs collected from five female participants. Samples were stored at either 4°C degrees or 25°C for 4,5,6,7, and 9 months. Across 9 months the DNA concentrations ranged from 0.347 ng/µL-30.2 ng/µL. The highest concentrations were the vaginal swab from the Pennsylvania State Police Sexual Assault Kit at 4°C for 4 months. The lowest concentration was the oral swab from the Pennsylvania State Police Kit stored at 4°C for 9 months.

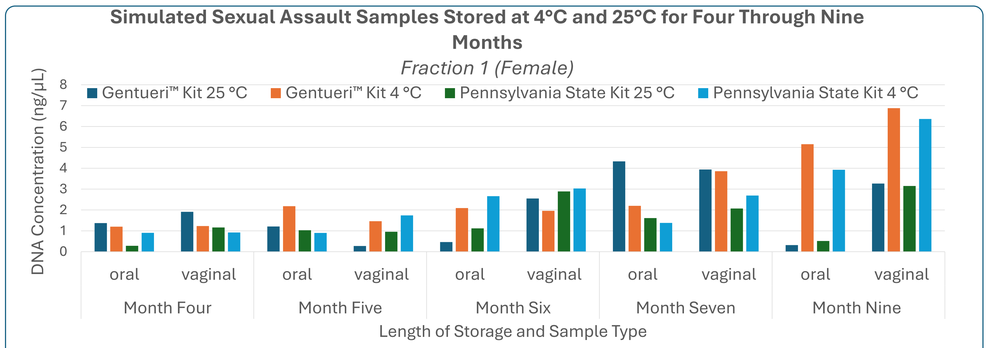


Figure 3: Total DNA Concentrations of fraction 1 (female) from oral and vaginal swabs collected from five female participants with semen deposited on them. Samples were stored at either 4°C or 25°C for 4, 5, 6,7 and 9 months. Across 9 months the DNA concentrations ranged from 0.285 ng/µL-6.88 ng/µL. The highest concentrations being the Gentueri™ Sexual Assault Kit oral sample stored at 4°C in Month 9. The lowest concentration was oral swab from the Pennsylvania State Police Kit stored at 25°C for 4 months.

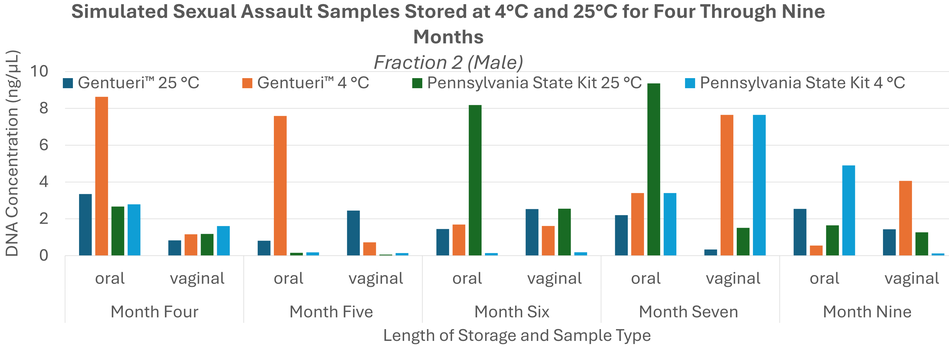


Figure 4: Total DNA Concentrations of fraction 2 (male) from oral and vaginal swabs collected from five female participants with semen deposited on them. Samples were stored at either 4°C or 25°C for 4, 5, 6,7 and 9 months. Across 9 months the DNA concentrations ranged from 0.141 ng/µL-8.63 ng/µL. The highest concentrations were from the Gentueri™ Sexual Assault Kit stored at 4°C for 4 months. The lowest concentration was an oral swab from the Pennsylvania State Police Kit stored at 4°C for 6 months.

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Statistical Analysis

Table 1: Statistical Analysis Results for the Comparison of the Gentueri™ Sexual Assault Kit and the Pennsylvania State Police Sexual Assault Kit

	Pooled variance	Degrees of Freedom	T Stat	T Critical one-tail	Conclusion
Fraction 1 Oral swabs at 25°C	8.92	8	1.24	1.86	Fail to reject the null
Fraction 1 Vaginal swabs at 25°C	0.868	8	0.346	1.86	Fail to reject the null
Fraction 1 Oral Swabs at 4°C	79.5	8	0.197	1.86	Fail to reject the null
Fraction 1 Vaginal swabs at 4°C	4.69	8	1.58	1.86	Fail to reject the null
Fraction 2 Oral swabs at 25°C	7.79	8	0.764	1.86	Fail to reject the null
Fraction 2 Vaginal swabs at 25°C	1.48	8	0.447	1.86	Fail to reject the null
Fraction 2 Oral swabs at 4°C	2.00	8	0.683	1.86	Fail to reject the null
Fraction 2 Vaginal swabs at 4°C	4.96	8	0.0919	1.86	Fail to reject the null
Female Reference Oral swabs at 25°C	21.8	8	0.897	1.86	Fail to reject the null
Female Reference Vaginal swabs at 25°C	39.9	8	0.224	1.86	Fail to reject the null
Female Reference Oral swabs at 4°C	59.3	8	0.528	1.86	Fail to reject the null
Female Reference Vaginal swabs at 4°C	43.7	8	2.00	1.86	Reject the null

Table 2: Statistical Analysis Result for the Comparison of 25°C and 4°C

	Pooled Variance	Degrees of Freedom	T Stat	T Critical One-Tail	Conclusion
Oral Swabs	62.8	30	0.422	1.67	Fail to reject the null
Vaginal Swabs	103.3	30	0.0400	1.67	Fail to reject the null

Conclusions

There was no statistical significance between the two kits except for the female reference vaginal swabs stored at 4°C. There was no statistical significance between the two temperatures of storage. Based on these results it can be concluded that the drying step can be successfully eliminated without detrimental effects on the DNA quantity with the use of a desiccant in the sexual assault kit.

Future Directions

- Store the samples for longer periods of time
- Test different humidities
- Test different sexual assault kits
- Look at DNA quality

References

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