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DNA integrity in forensic samples

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Introduction:

Cross-Contamination is when DNA in unintentionally transferred between different objects, and especially between DNA samples. It is a big problem because it can occur at any point during the investigation process and the contamination can interfere with the integrity of the sample, leading to false interpretations of genetic evidence. Over the years, the rates of contamination have been increasing, when they should be decreasing.

Hypothesis:

1. If packaged genetic evidence samples are stored in close proximity to one another, then there is a higher chance for cross-contamination (DNA moving between samples).

2. The longer the samples are in storage, the more contamination will occur.

3. The longer the sample dries before storage will reduce the overall probability of contamination occurring during storage.

Method:

DNA Source to "contaminate" samples: Pig (*Sus scrofa*)
PurFlock Ultra DNA-Free Swab

- Stored in labeled evidence envelope with an A & B swab, sealed with ActiSeal Evidence-Pro tape then placed into storage
- A Swabs were introduced to DNA, then left to dry (time: none, one hour, or 24 hours)
- B Swabs were blank, left unopen
- Control where both samples were left blank

Whatman Cards

- Stored in labeled evidence envelopes with either an A or B Whatman card, sealed with ActiSeal Evidence-Pro tape then placed into storage
- A Swabs were introduced to 50 microliters of DNA, then left to dry (time: none, one hour, or 24 hours)
- Control

Qubit

- 5 μL of DNA in the dsDNA high-sensitivity assay
- Used to read the concentration of DNA in a sample

PCR

- Pig Primers (CO2susF2; CO2susR2)
- Used to amplify species-specific mtDNA

If DNA can migrate through packaging, then the integrity of genetic evidence in storage becomes jeopardized

Contamination was **detected**; therefore it **can** occur during storage.

Dry Time	Storage Time: 72 Hours	14 Days	45 Days
None	3 Blank 3 DNA 2 Control	3 Blank 3 DNA 2 Control	3 Blank 3 DNA 2 Control
1 Hour	3 Blank 3 DNA 2 Control	3 Blank 3 DNA 2 Control	3 Blank 3 DNA 2 Control
24 Hours	3 Blank 3 DNA 2 Control	3 Blank 3 DNA 2 Control	3 Blank 3 DNA 2 Control

Results:

Storage time:

STORAGE TIME:	72 HOURS	14 DAYS	45 DAYS	P-value
BUCCAL SWAB	3		5	0.054
WHATMAN CARD	1		9	0.00

- The table indicates the number of contaminated blank samples (the B swabs/cards) during storage.
- If contamination is not due to extraction error, then the possibility of cross-contamination during storage time is not that significant.
- The longer a sample remains in storage the more likely contamination is too occur.

Dry time:

DRY TIME:	NONE	ONE HOUR	24 HOURS	P-value
BUCCAL SWAB	3	3	2	0.584
WHATMAN CARD	3	4	3	1.00

- The table indicates the number of contaminated blank samples based on drying time.
- There is no significance in the amount of time samples were left to dry before storage in relation to cross-contamination during storage

Discussion

In both the swabs and the Whatman cards, cross-contamination was detected in a significant number of blank samples.

Pig DNA was used as a proxy for human DNA to demonstrate that human handling was not the contamination source. Further research is being done using human DNA to determine if contamination can still be detected after storage.

Without using CODIS markers (autosomal STR markers used by law enforcement), it is impossible to know if similar results would be achieved, but regardless of the species DNA carryover can be detected, including the potential for cross- contamination during typical storage that's carried out in labs around the country.