Touch DNA Recovered from Fired and Unfired Shotgun Shells

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ABSTRACT

A Research Project was designed and conducted to evaluate the possibility of developing *touch DNA* from both fired and unfired, but handled shotgun shells. Modeled after similar research done with different handgun casing materials, we attempted to expand the data gathered on touch DNA and its applications. It was hypothesized that there would be a higher yield of DNA recovery off of shotgun shells than of metallic pistol or rifle cartridge casings. The results of this experiment indicated that we are able to obtain DNA in about 18% of samples which is a similar percentage of samples to the previous research with handgun cartridges.

INTRODUCTION

In recent years, the sensitivity of DNA testing has increased to the point where DNA can now be located in places we not have previously considered. DNA can now be found on objects simply from a person contacting that object and transferring it to the surface when otherwise we would have been limited to looking for DNA in places where we located a biological fluid. This type of transfer has been aptly named *Touch* DNA and it refers to the DNA found in the skin cells shed and trapped in the oils transferred by contact.[4,6] These oils are often what comprise fingerprints and they can be found on almost any surface, which opens up a new world of places for investigators to look for DNA.

This experiment was designed to test if touch DNA could be recovered and detected from swabbing both fired and unfired shotgun shells. In this experiment 90 shells from three participating shooters were collected and processed for DNA yielding a total of 16 shells having detectable levels of DNA on them.

Recent studies have been conducted to determine the minimum quantity of DNA needed to generate both a partial and a full profile, as well as an average amount of skin cells shed and left suspended in fingerprints. Other studies focus on gathering statistical data on new places investigators should begin testing for touch DNA. Research and experiments such as these are conducted to improve current investigative procedures increasing the amount of information that can be gathered from physical evidence.

DISCUSSION

Forensic scientists can use a *shedder test* to determine the average amount of skin cells shed from leaving a fingerprint. This information is used to determine the likelihood that someone is to leave touch DNA from contacting an object.

Generally speaking, touch DNA is more difficult to find because of the many variables involved with its transfer and retention, such as how much oil a particular fingerprint will leave, or how many skin cells will be shed in that fingerprint. Furthermore, the length and type of contact as well as the object surface are factors in this process. These, among other variables, make the consistent transfer of DNA difficult to reproduce.[4,6]

In our experiments, we controlled as many variables as were feasible in areas such as the loading and ejection processes. We also adhered to accepted laboratory protocols in the handling of the shells that potentially contained DNA. Despite our best efforts, two samples were contaminated during our experimental process and were eliminated from our study prior to the DNA extraction process. Blank swabs were tested as negative controls for the extraction process, however no unhandled shells were tested. Each negative control had no detectable DNA present during the quantification process.

Herter's 12-Guage Slug shells used as sample ammunition

MATERIALS & METHODS

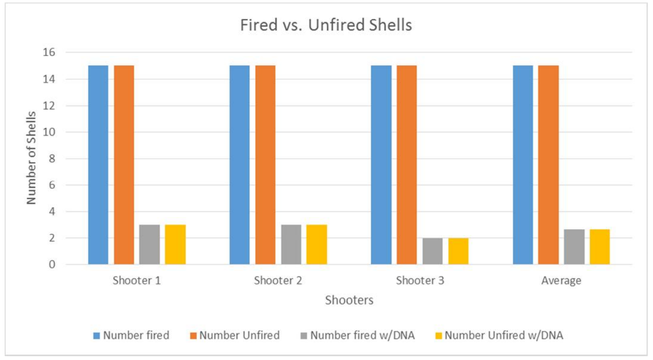
A Mossberg 500 Shotgun was used along with Herter's brand 12-gauge shotgun shells. A sample size of ninety shells was chosen so that three separate participants could load and fire fifteen shells, followed by loading and unloading fifteen additional shells which were not fired. All participants assembled at a shooting range and loaded each of their own shells to be fired.

Once fired, the expended shells were ejected into individual evidence bags which were then labeled for each shooter. Similarly, the unfired shells were loaded then unloaded by each shooter and placed in evidence bags. Each participant only handled the ammunition when loading to mimic a normal loading process. All ninety samples were transported back to the lab for further DNA processing.

Each shell was carefully removed from the evidence bag followed by swabbing for touch DNA via a double swabbing method. By using one wet sterile cotton swab followed by one dry sterile cotton swab, the entire external surface area of the shell, minus the brass section, was swabbed for DNA. The tips of the cotton swabs were then broken off into sterile 2mL tubes.

Each sample was then subjected to the extraction process with a Qiagen Investigator DNA extraction kit, with a slightly modified lab manual procedure. In order to increase yield, an additional step was included by using a spin basket to remove all liquid from the swabs which as been shown to increase DNA recovery.

Once each sample was extracted, they were put through forty cycles of PCR DNA amplification along with controls and standards. Once completed, the sampled were then quantified to determine amount of DNA present in each sample. As a result of this process, detectable levels of DNA were found in approximately 18% of the final eighty-eight samples.



Quantities of DNA Recovered from Samples			
Unfired	Shooter 1	Shooter 2	Shooter 3
1	3.14E-03	2.35E-03	3.77E-03
2	3.60E-03	2.15E-03	4.24E-03
3	6.98E-03	8.84E-03	n/a
Fired			
1	1.05E-02	1.67E-02	7.74E-03
2	4.30E-03	5.63E-03	1.87E-03
3	3.99E-03	1.86E-03	n/a
Weight in nanograms (1x10^-9 grams)			

Mossberg 500 shotgun used for creating samples

Results

Each shooter handled thirty separate cartridges in small groups of only five shells. This was done with the understanding that repeated contact with a surface might decrease the amount of DNA transferred in later contact. Of the 90 shells fired, only 88 samples made it to the final quantification and sixteen samples, approximately 18.18%, had a detectable amount of DNA. This shows that it is possible to recover DNA from both fired and unfired shotgun shell. Conclusions about the composition of the material touch DNA was recovered from, or the effect of the firing process on the degradation of the DNA, cannot be made without further testing.

CONCLUSIONS

Similar studies have been conducted with different variables using different firearms as well as different cartridge casing materials. Another university's results showed that pistol bullet casings made of brass and nickel plated yielded results ranging from 13% to 36% DNA recovered with a similar procedure. The results of this experiment yielded approximately 18.18% DNA recovery. In conclusion, it is possible to recover touch DNA from fired and unfired shotgun shells with a similar rate of success seen for bullet cartridge cases made of nickel and brass. While the percentage of recovery is relatively low, it is evidence that touch DNA can be recovered from both fired and unfired shotgun shells.

I plan to continue this research by determining whether the DNA recovered from the 18% of cases is a single source profile corresponding to our shooter or if there was potentially DNA present on the shells potentially transferred during the manufacturing process. Furthermore, my research will look at full as well as partial profiles to determine whether the firing process contributes to the degradation of the DNA on the shell.

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