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Original Research Article

DNA PROFILING FROM EYE WEAR FOR PERSONAL IDENTIFICATION

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ABSTRACT

According to a 2020 survey, 45% of the Indian population utilizes spectacles. The aim of this study is to identify and extract DNA from the nose pads of bespectacled individuals, which can serve forensically in the identification and resolution of crime cases. It has been observed that sweat accumulated around the nose pads of bespectacled individuals can potentially contain DNA for individualization. The presence of DNA in human sweat suggests the presence of cells, such as sloughed-off skin cells, within the sweat itself. In this study, Sweat-derived DNA was separated and quantified using agarose gel electrophoresis (0.8%). After that, 1.0ng of the DNA was amplified by multiplex PCR using PowerPlex 21 and GlobalFilerTM kits. Using genetics analyzers 3130 and 3500XL, capillary electrophoresis of the amplified products was carried out. Following that, the data were examined using GeneMapper ID Software Version 3.2 and GeneMapperTM ID-X software v1.6, which yielding successful identification results. Despite varying weather conditions, complete DNA profiles were obtained from 87.3% of the samples. The findings suggest that sweat collected from bespectacled individuals can serve as a reliable source for DNA profiling, offering potential advancements in forensic investigations..

Keywords: PCR amplification, DNA profiling, Bespectacled, Sweat

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INTRODUCTION

During criminal investigations, DNA often serves as crucial evidence recovered from handled items. While studies have explored individuals' tendencies to deposit DNA, little is understood about the mechanisms underlying DNA transfer through touch.

Touch DNA, also known as trace DNA or low copy number DNA, has gained attention recently due to its significance in the absence of additional biological evidence. However, there hasn't been much work done to develop touch DNA collection techniques. Effective DNA typing relies on existing DNA templates, influenced by factors such as shedder status, surface type, contact pressure, and DNA collection and extraction techniques. Understanding and optimizing these parameters are essential for efficient DNA analysis from touch DNA (Alketbi et al., 2018; Salem Khalifa et al., 2018).

The epidermal cells known as keratinocytes are devoid of a nucleus. These cells gradually experience chromatin condensation and nucleus shrinking as they approach the skin's surface during the keratinization process. Eventually, the cells fill with keratohyalin and keratin filaments and lose their nuclei. As a result, it's thought that these cells lack DNA. As a result, it is still unknown where touch DNA (tDNA) originated. According to research, nucleated cells can be transported by touch, which means that they could come from other bodily regions or even peel off from sweat ducts. (Quinones & Daniel, 2012).

It was shown that 1 mL cell-free sweat samples could give an average yield of 11.5 ng of DNA, indicating that during item handling, cell-free nucleic acids (CNAs) of appropriate lengths for conventional DNA profiling are transmitted. The glass bead method made it easier to create sets of identical tDNA samples, which allowed for direct comparisons of the effectiveness of different extraction techniques. In a broad population investigation, extraction techniques designed to maximize CNA recovery from touched publications produced results that were equivalent. But using these techniques doubled the amount of DNA yielded from objects handled by people whose hands were perspiring. These results suggest that tDNA profiling can be more successful when the CNA component of contacted surfaces is included. (Quinones & Daniel, 2012).

Touch DNA collection methods also feature prominently, with studies evaluating the effectiveness of various swab types in recovering DNA from different surfaces. Notable variations in allele amplification rates and DNA recovery efficiency among swabs highlight the importance of selecting appropriate collection materials, such as the highly efficient PurFlock® swab, particularly for recovering small DNA amounts from surfaces implicated in criminal activities (Alexandre Giovanelli et al., 2021; Rodrigo Grazinoli Garrido et al., 2021).

Investigations into the nucleic acids associated with perspiration particles underscore the potential of perspiration acting as a useful source of DNA in forensic scenarios. Despite the limited prior focus on nucleic acids in sweat, emerging research suggests promising avenues for DNA recovery and analysis from perspiration traces, offering new insights into the biological components of sweat and their forensic implications (Genevieve Bart et al., 2021; Daniel Fischer et al., 2021). The development of DNA methylation-based assays for distinguishing skin cells from other bodily fluids holds significant promise for forensic applications. By identifying epigenetic skin markers and utilizing high-resolution melt analysis, researchers have demonstrated the feasibility of differentiating skin/sweat DNA from other bodily fluids, thereby enhancing the specificity and accuracy of forensic DNA analysis (Nicole Fernandez-Tejero et al., 2022; Quentin Gauthier et al., 2022).

Moreover, studies examining the genetic material present in perspiration and grease deposits further emphasize the possibility of using perspiration as a reliable source of DNA evidence for legal cases. The analysis of DNA quantity and allelic combinations from sweat traces on recipients' skin highlights the complexity of interpreting DNA analysis results in such scenarios, underscoring the importance of comprehensive forensic examinations (T.G. Faleeva et al., 2018; I.N. Ivanov et al., 2018).

Advancements in DNA extraction techniques, such as the use of automated extraction systems and physical extraction strategies, have significantly enhanced the efficiency and reliability of DNA recovery from various crime scene exhibits, including sweat traces. These ad-

vancements have facilitated the acquisition of full STR profiles, enabling more accurate forensic analyses and reducing the risk of contamination (M. Pizzamiglio et al., 2006; A. Marino et al., 2006).

Overall, the literature review highlights the multifaceted nature of DNA extraction from sweat and its relevance to forensic investigations.

OBJECTIVE

- Collection of samples of sweat from tear.
- To identify best suitable collection method
- Quantitative estimation of DNA By electrophoresis and PCR

METHODOLOGY

•SUBSTRATES AND CONTACT SIMULATIONS

For collecting samples ten male and ten female volunteers using spectacles for more than a weak were asked to remove spectacles (exogenous DNA). After that to collect DNA from the spectacles we use dry swab method. So, for collect DNA from the spectacle's dry swabs moist with distilled water were rubber with moderate pressure and rotation on both surfaces (internal and external) of the spectacles nose pads. Then the swabs were kept in autoclaved vacutainers and kept under refrigeration at -20 degrees till further analyses.

• DNA ANALYSIS

All the samples collected were placed in a 1.5ml tube and DNA extraction was performed organic method (PCI). In this work, agarose gel electrophoresis (0.8%) was used to quantify the extracted DNA from sweat, and GlobalfilerTM PCR amplification kits were utilized to perform multiplex PCR amplification on 0.1 ng of DNA. The amplified products were then subjected to capillary electrophoresis using 3500XL genetics analyzers. Then, geneMapper ID software version 1.6 was used to evaluate the data.

RESULTS

20 samples were collected from ten males and ten females, Results of our study showed that 16(80%) generates complete profile whereas 2 (10%) yielded partial profile and 2(10%) showed no results.

Figure 1.1: samples are in gel electrophoresis

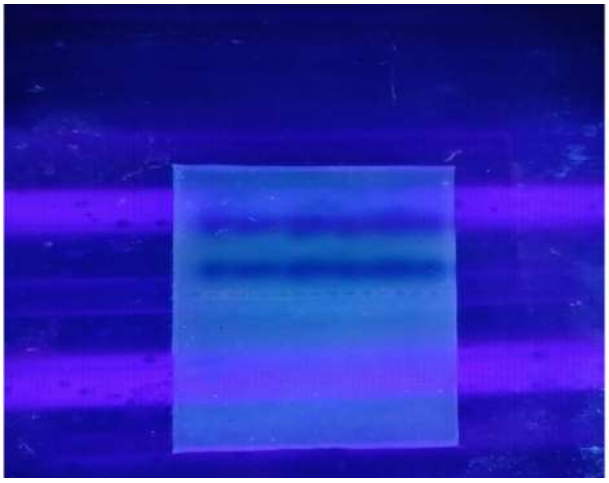

Figure 1.2: result showing DNA samples in gel electrophoresis

Partial DNA profiles with alleles dropouts showed the low intensity of DNA with lower copy numbers of PCR products.

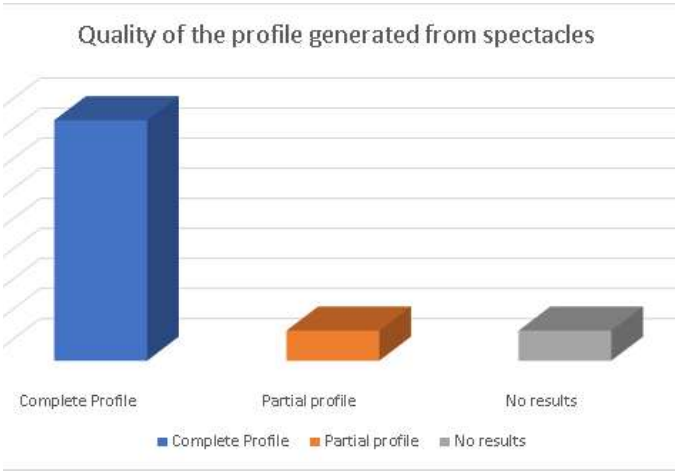

Figure 1.3: The quality of profile generated from spectacles

Table 1.1: Data quality obtained by the process of gel electrophoresis

Sample no	Quality yield
1	Good DNA
2	Good DNA
3	Good DNA
4	Good DNA
5	Good DNA
6	Good DNA
7	Good DNA
8	Good DNA
9	Good DNA
10	Good DNA
11	Good DNA
12	Good DNA
13	Good DNA
14	Good DNA
15	No DNA
16	Partial DNA
17	No DNA
18	Partial DNA
19	Good DNA
20	Good DNA

DICUSSION

The mean quantity of DNA extracted from sweat samples devoid of cells, was demonstrated by Quinones & Daniel (2012), highlights the existence of cell-free nucleic acids (CNAs) in sweat that are appropriate for conventional DNA analysis. This supports the research paper's objective of identifying and obtaining DNA from perspiration, demonstrating perspiration's potential as a useful source of DNA for forensic applications. How effectively touch DNA gathering techniques work, as evaluated by Alexandre Giovanelli et al. (2021) and Rodrigo Grazinoli Garrido et al. (2021), emphasizes the importance of selecting appropriate swab types for DNA recovery from different surfaces. The notable variations in allele amplification rates and DNA recovery efficiency among swabs highlight the significance of optimizing collection materials, comparable when the research study uses particular extraction techniques designed to maximize CNA recovery from impacted articles.The investigations into the nucleic acids associated with perspiration particles, conducted by Genevieve Bart et al. (2021) and Daniel Fischer et al. (2021), give more evidence in favour of the study article's assertion that perspiration can be a source of DNA in forensic situations. These studies offer insights into the biological components of sweat and their implications for DNA recovery and analysis, reinforcing the significance of sweat in forensic investigations. Moreover, the development of DNA methylation-based assays, as demonstrated by Nicole Fernandez-Tejero et al. (2022) and Quentin Gauthier et al. (2022), holds promise for distinguishing skin/sweat DNA from other bodily fluids. This aligns with the research paper's emphasis on enhancing the specificity and accuracy of forensic DNA analysis, particularly in differentiating sweat DNA from other sources.

Additionally, the studies examining genetic material present in perspiration and grease deposits, such as those by T.G. Faleeva et al. (2018) and I.N. Ivanov et al. (2018), underline once more how useful perspiration can be as a source of DNA evidence for criminal investigations. The analysis of DNA quantity and allelic combinations from sweat traces reinforces the complexity of interpreting DNA analysis results, highlighting the importance of comprehensive forensic examinations.

Finally, advancements in DNA extraction techniques, as discussed by M. Pizzamiglio et al. (2006) and A. Marino et al. (2006), underscore the significance of utilizing automated extraction systems and physical extraction strategies to enhance the efficiency and reliability of DNA recovery from various crime scene exhibits, including sweat traces. These advancements align with the research paper's utilization of advanced extraction methods to maximize DNA profiling success from sweat samples.

In this unique study, touch DNA samples were collected from blood, saliva, and trace samples using Copan dry swab methods. After PCR amplification, the results showed a 100% success rate for samples obtained from blood and saliva. However, for samples collected from trace objects, an 84% success rate was achieved. Specifically, when touch DNA was collected from the nose pads of spectacles and subjected to PCR amplification, the results revealed an 85% complete profile, along with 2% partial profile and 2% no result.

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CONCLUSION

As with other evidence recovered from the murder scene, spectacles are considered to be potentially valuable evidence that might be utilized as a source of trace DNA for profiling due to prior human contact. A spectacle exhibit can considerably contribute to the logged and harboured amount of DNA in a contacted sample from a specific individual employed previously with basic observation established by a well-known recovery process. The study's findings additionally showed how DNA amplification and recovery success are impacted by the persistence of DNA on eyeglass surfaces. It examines the extent and effectiveness of existing methods for direct amplification, extraction, and sampling, and offers pertinent suggestions for enhancing forensic trace DNA recovery. The current study's use of DNA profiling shown that recovering eyeglasses from a crime scene can yield sufficient samples to construct a DNA profile. The study also highlights the effective profiling of eyewear as a possible source of DNA samples discovered at crime scenes for criminal correlation or for the purpose of forensic investigation in investigative profiling. To improve knowledge of the interactions between eyewear and DNA in the context of forensic investigations, a great deal of research is required. This should involve a methodical investigation to assess how environmental exposure, material type, and other factors affect the amplification, persistence, and recovery of trace DNA samples. Better sample gathering, extraction, and cleanup procedures will result from this, which will enhance the profiling of DNA retrieved from eyewear.

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