

QUANTIFICATION AND PURITY ASSESSMENT OF TOUCH DNA EXTRACTED FROM LATEX HAND GLOVES

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Introduction



- DNA profiles can be obtained from ‘trace DNA’ evidence, which comprises microscopic traces of human genetic material.
- The examination of trace DNA through forensic science has abundantly aided most investigative department with the judicial exoneration or conviction of alleged persons as these DNA are deposited constantly by contacts established between individuals and the surrounding’s surfaces (Dinis, 2017), hence trace DNA and the use of DNA expert opinion has received full acceptance and adoption in the universal constitution and the constitutional laws of the federal republic of Nigeria as amended in 1999 (Oko, 2018).
- Organized crime adopts the use of protective materials to conceal traces of genetic material that may be deposited at the crime scene, which decreases the chances of genetic imprinting (Nwabughogu, 2017).

Statement of Problem



- The recovery of trace DNA from crime scene for examination process and criminal identification has been a challenging course over decades. The availability of dispersed trace DNA is highly reduced in some crime scenarios, where mindful perpetrators shield their touch DNA yield by wearing protective materials such as hand gloves, facial masks, trench coat, etc. This premeditated protection decreases the chances of cross-examination due to an almost total absence of recoverable genetic information from those crime scenes; but the used hand gloves could be surprisingly disposed within a considerable radius around the approximated scene and a design to qualitatively identify and analytically represent this evidence before a judicial system is required (Kumar, et al, 2013).

Justification



- Organized crimes that increase human victimization and societal degeneration are evidently manifesting in traumatized citizens, loss of motivated human resource and invested properties that are attributed to vague methods of evidence discernment, dreadfully down-casts the resolute powers of the countrywide judicial system (Oko, E. O. (2018)).
- Forensic DNA analysis appraised by the establishment of DNA centres in Lagos state and the Federal Capital Territory of Nigeria, for law enforcement agencies, proposes powerful principles to provide these agencies with evidential data for legal consideration.

Justification



- The interpretation of crime scenes' recovered trace DNA samples has valuable value as verdict and eventually enhances safety consciousness in the hearts of citizens as is the duty of the national security units; (USDOJ, COPS website, 2011).

Aim and Objectives



- The aim of this study is to evaluate cost-effective method of trace DNA recovery with sufficient STRs for PCR amplification and Forensic typing.
- To determine the presence of trace DNA in the inner area of latex hand gloves.
- To quantify the amount of touch DNA recover from selected sections of latex gloves.
- To compare double swabbing and substrate cutting methods of obtaining touch DNA.
- To ascertain the purity of the isolated DNA samples.



- Volunteers from the Africa Centre for Neglected Tropical Diseases and Forensic Biotechnology (ACENTDFB) were asked to wear latex hand gloves in both hands for different durations of time, followed by double swabbing of distinct inner sections and whole inner surface of the hand gloves to recover possible trace DNA samples. Also, substrate cut-outs of those inner areas are recovered for quantification and purity assessment.
- All experiments were conducted after signing ethical consent form and washing of both hands with disinfectant soaps.

Sampling Methods



- The inside section of twenty pairs of latex hand gloves were sampled for “touch” or “handler” DNA using sterile cotton swab moistened with distilled water (double swapping method) and an approximately 1cm³ substrate cut-outs. Extraction of DNA from sample swabs and cut-outs were carried out using a Quick-DNA Miniprep DNA Kit (Zymo Research) according to the manufacturer's recommended protocols for solid substances. An included extraction blank is necessary as negative control. Recovered DNA was quantified using NanoDrop Spectrophotometer according to the manufacturer's recommended conditions (Farash, et al. 2017).
- Statistical analyses will be performed on the collected data using Microsoft Excel Package.

Result

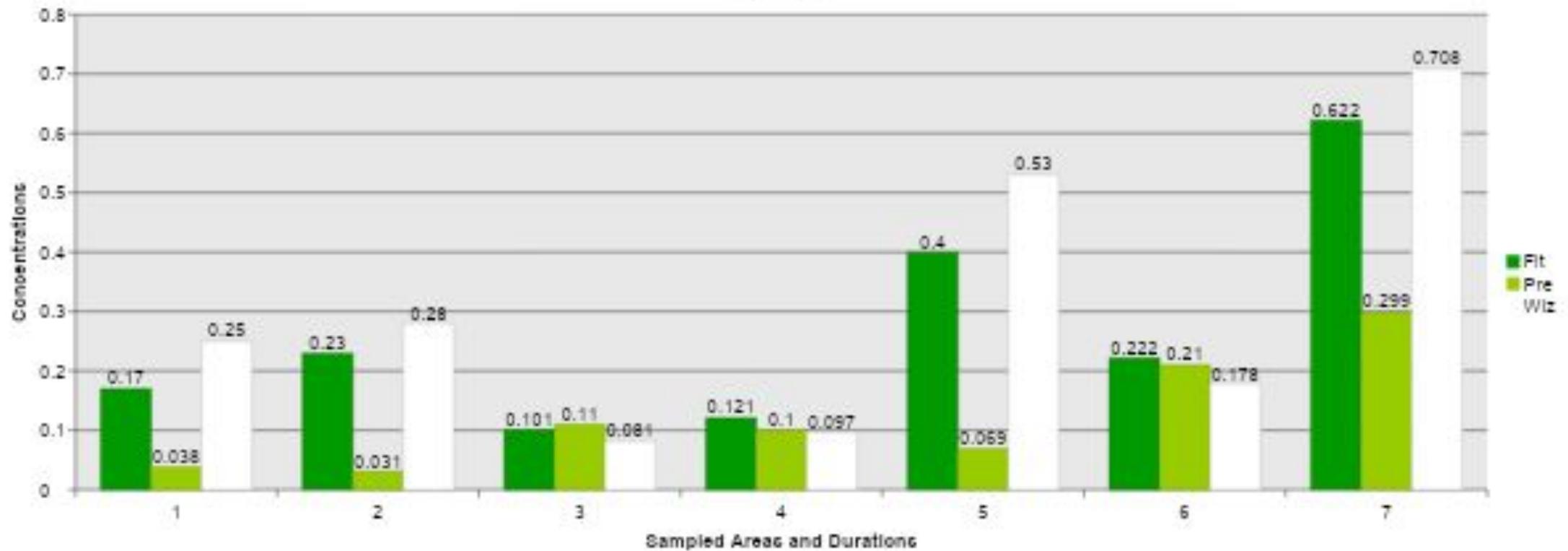


- Double swabbing for fingertips had the values of 0.17ng/ul and 0.23ng/ul at 15minutes and 30minutes respectively; while the substrate cutting method produced a totalled 18%, which were below significant levels. Whole inner surface had the highest percentages for double swabbing and lowest for substrate cutting. Recovery of trace DNA has a higher success rate when double swabbing method, at a totaled 0.53ng/ul, is applied compared to substrate cuttings at 0.22ng/ul which were both suitable profiles for STR comparison.

Mean Concentration



Mean concentration of Touch DNA detected in various sections of latex hand gloves

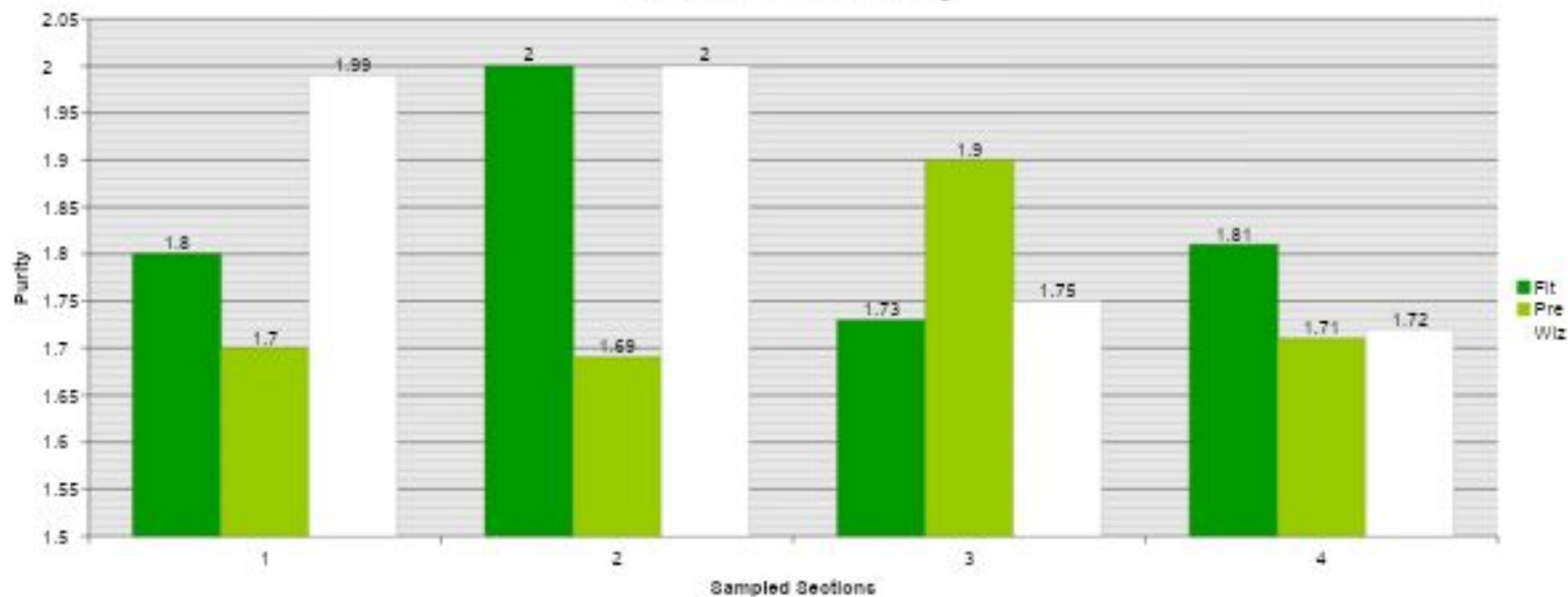




- It is observed that the purity of the DNA samples analyzed all produced ≥ 1.70 purity value except in entire palm regions region during double swabbing method at 30minutes which was 1.6.
- Also the maximum value of purity attained was 2.00 for fingertips and whole inner surface using double swabbing method at 30 minutes.



Concentration Purity





- The yield of recoverable trace DNA from the sampled areas in this study indicates that whole inner surface (37.5%) is a major contributor of primarily transferred DNA, perhaps as the fingers are closely clenched while handling instruments hence sweat and moist at this location favours more shedding of genetic materials compared to other areas (Daly, et al, 2012).
- The mean concentrations were directly proportional to the pre-processing method used. Direct substrate cutting and double swabbing technique are basically selected because of their cost-effective nature and the simplicity of the methods in real-time (Foran, et al, 2016).



- During comparison of these pre-processing methods for touch DNA samples, we found that the mean concentrations of double swabbing technique were considerably higher than substrate cutting method thereby producing better result. This significant difference may be attributed to the nature of the sampled surface since dampened surface readily enhance the transfer of touch DNA compared to parched surfaces in the case of substrate cutting.
- The method of extraction and nature of the swabs' surface should be the possible reason for the standard value of purity that was generally obtained with the double swab method as foam swabs has been identified by Daly, et al (2012) to have high recovery success rate with low contamination properties.
- Time differences were negligible.

Conclusion



- This research has demonstrated that recovered trace DNA from specific regions of latex hand gloves affect the amount of transferable trace DNA that can be used for forensic DNA examination. The little differences in time during crime, should not hinder the forensic identification of perpetrators in similar scenarios. Through the use of this cost-effective method of extraction, isolation of trace DNA for forensic analysis is scientifically feasible principally, when this technique is applied in sterile environment it produces considerable quantities of recovered DNA for STR profiling.

References



- Dinis, V. (2017.). Comparative study between a direct DNA quantification methodology and the standardized methodology in the forensic workflow,. *Forensic Science International: Genetics Supplement Series*,, 13-17
- Thomasma, S.M., E. A., & Foran, D.R. (2013). The influence of swabbing solutions on DNA recovery from touch samples,. *J. Forensic Sci.*, 58: 465–469.
- Oko, E. O. (2018). The Nigeria Police Forensic Investigation Failure. *J Forensic Sci & Criminal Invest.*, 9(1): 555752.
- Foran D., H. L. (2016). Trace DNA from Fingernails: Increasing the Success Rate of Widely Collected Forensic Evidence December 2015. <http://www.fflm.ac.uk/>, 11-19.
- Daly D. J., M. C. (2012). The transfer of touch DNA from hands to glass, fabric and wood. *Forensic Sci Int Genet.*, 6: 41-46.
- Farash, K. H. (2015). Enhanced Genetic Analysis of Single Human Bioparticles Recovered by Simplified Micromanipulation from Forensic ‘Touch DNA’ Evidence. *Journal of Visualize Experiment* (97), e52612, doi:10.3791/52612, 1, 3.