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Isolation and Amplification of Touch DNA from Portable Computer

Miriam Jasim Shehab Majeed Arsheed Sabbah Dhuha Salim Namaa Sura Nabeel

Forensic DNA Research and Training Center /Al-Nahrain University / Baghdad - Iraq
Corresponding author: **miriam291083@gmail.com**
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Abstract

Analysis of touched DNA from crime scenes is fundamental in forensic DNA laboratories. Many factors affect the recovery of DNA from touched surfaces and then affect the quality of the final results. The aim of this work is studying the possibility of recovery suitable amount of DNA from ltouched portable computer. The computer was cleaned with 10% Bleach then touch and DNA collected for extraction by Organic method and two STR regions D5S818 (115-163bp) and FGA (308-464bp) were amplified. The results showed that it is possible to isolate a proper amount of DNA from touched portable computer where it was amplified and then analyzed by Agarose gel electrophoresis. The conclusion is that portable computer is suitable source for forensic analysis.

Key words: Touch DNA, Crime scenes, Portable computer.

Introduction

In some crime scenes there are no biological, physical and visible proof accessible to inspector. In this situation, DNA that transferred from the suspect through contact with evidences found at the crime scene may be help in crime investigation. Touch DNA or Trace DNA refers to the DNA that recovered from epithelial cells (skin) when a person comes in contact or handled items such as clothes, a weapon or other objects (1). Individual shed about 400,000 skin cells every day and these cells may be transfer to contacted surfaces (2). These cells contain either fragmented DNA or cell-free nucleic acids and can contain enough DNA to produce a genetic profile using polymerase chain reaction (PCR) amplification techniques (3). Utilizing Short Tandem Repeat (STR) markers and analysis its result with genetic analyzer instrument for generation individual's DNA profiling is considered important technique used in forensic field and paternity testing (4). The quantity of DNA that required for DNA analysis by genetic analyzer range between (1.0- 2.5ng) which equal to 200 cells (5). There are many factors influence on the quantity and quality of extracted DNA from surfaces some are related with nature of surface and other related to methodology of collection sampling, isolation, analysis DNA and even individual's tendency to deposit DNA on surfaces when touch it (6-9). Several studies conducted to analysis touch DNA isolated from many surfaces such as cell phones (10), Optical Data Disc (11), latex gloves (12). The destination of this study was determining the capability of isolation touch DNA from portable computer surface.

Materials and methods

Subjects

Three portable computers with different brand were chosen (lenovo, hp and Dell laptops), some have a matt surface and other have polished smooth surface.

DNA extraction

Before samples collection the surface of portable computers were cleaned with cotton piece wetted with commercial bleach (10%) then with distilled water and left surface to dry (13). Twenty Touch DNA samples were collected from different volunteers, furthermore twenty buccal swabs collected from buccal cavity from the same volunteers as references samples. The volunteers didn't wash them hand for (2 hours) and touched the portable computer from different places for one minute. The samples were collected from contact surfaces by utilizing wetted cotton swabs, while reference samples were collected from buccal cavity by using dry cotton swabs. Both touch DNA and buccal swab samples were

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extracted by organic method according to a previously published protocol (14).

Measuring quantity and quality of DNA

Concentration and the purity of isolated DNA were measured using Nanodrop (Thermo Fisher /USA).

Agarose gel electrophoresis

Extracted DNA was subjected to agarose gel electrophoresis to confirm the presence and integrity for both gDNA and PCR products.

PCR amplification

Larger and smaller STR marker (FGA and D5S818) were amplified by using specific primers according to accession number in (GenBank: M64982, AC008512, respectively) (table 1)

Table 1: primer sequences of FGA and D5S818 loci and their band size

STR loci	Primers		PCR product size
FGA	Forward primer	5'GGCTGCAGGGCATAACATTA'3	308-464 bp
	Reverse primer	5'ATTCTATGACTTTGCGCTTCAGGA'3	
D5S818	Forward primer	5'GGTGATTTTCCTCTTTGGTATCC'3	115-163 bp
	Reverse primer	5'AGCCACAGTTTACAACATTTGTATCT'3	

PCR was performed with a total volume of 25 µl. The reaction components consist of 12.5 µl of go tag green master mix (Promega, USA): TaqDNA polymerase, dNTPs, MgCl2 and reaction buffer pH 8.5), 1 µl forward primer, 1 µl reverse primer, 10 µl DNA template and 2.5 µl free nuclease distilled water. The PCR thermo cycler was run with following program: 95˚C for 5 min (initial denaturation) followed by 35 cycles of 95˚C for 30 s (denaturation), 57˚C for 40 s (annealing), 72˚C for 45 s (extension) and a final extension of 72˚C for 5 min. Then, PCR products are separated on 2% agarose gel with the present of (800-50 bp) DNA ladder and visualized under UV light of transilluminater.

Result and discussion

This study was conducted for assessment of DNA analysis which has been isolated from a portable computer after been touched. Some STR loci using in global laboratories kits were amplified.

Short tandem repeat analysis is important identification tool in forensic field. There are many STR kits which use for this purpose but the best of them, the one that test more STR region (loci) in an individual and is considered a powerful discrimination kit. Due to very expensive cost of STR kits and difficulties that faces researcher in obtain a like kits, therefore this research was restricted to amplification of larger and smaller STR marker which are FGA and D5S818 respectively, and analysis on agarose gel electrophoresis.

Result, have shown that the concentrations of DNA which were isolated from buccal swab samples ranges between (35-152 ng/ µl) and the purity ranges between (1.5- 1.9) while the concentrations of DNA which were isolated from a touched smooth laptop surface samples ranges between (0.00 - 22 ng/ µl), and that isolated from a touched matt laptop surface samples ranges between (0.00 - 36 ng/ µl). Whereas the purity ranges between (0.03 -1.6) and (0.03 -1.8) respectively (table 2), Some of tested samples that isolated from touched laptop surfaces show no DNA concentration when measured with

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nanodrop instrument (the percentage of negative results are 40% for samples isolated from touched polish smooth surfaces and 20% for samples isolated from touched matt surfaces). This may indicate that DNA is not always transfer through touched alone and this can be explained that some individuals tend to shed skin cells in greater rate than others who cannot leave enough DNA behind them to yield a DNA profile (15-18). In addition, the quantity of DNA that is transferred to touched objects depended on other factors such as nature of the surfaces in contacted (Rough surfaces tend to reserve skin cell DNA better than smooth surfaces), pressure and friction with contacted objects can also increase amount of transferred DNA (19).

Table 2 : The concentrations and purity of DNA extracted from both touched laptop surfaces and buccal swab samples

Dell and hp laptop brands (Smooth surface)				Lenovo laptop brand (Matt surface)			
Touch DNA samples		Buccal swab samples (reference)		Touch DNA samples		Buccal swab samples (reference)	
Concentration (ng/ µl)	purity	Concentration (ng/ µl)	purity	Concentration (ng/ µl)	purity	Concentration (ng/ µl)	purity
4	1.3	56	1.8	11	1.2	79	1.7
2.6	0.9	98	1.8	0.9	1.0	100	1.8
17	1.6	47	1.6	7	1.2	72	1.7
0.00	0.03	137	1.8	0.00	0.04	133	1.8
3	1.0	85	1.9	0.00	0.03	46	1.8
12	1.3	94	1.7	3.1	1.0	125	1.9
0.00	0.07	112	1.9	36	1.8	56	1.9
22	1.6	78	1.8	6	1.5	35	1.8
0.00	0.03	38	1.5	14	1.5	91	1.9
0.00	0.06	152	1.6	8	1.0	108	1.5

Generally, DNA is accepted as ‘pure DNA’ when the ratio is~1.8 (20). In this study, the purity was lower than the ratio A260/A280 of pure double-stranded this could be due to contamination of the samples with proteins and phenol.

Electrophoresis analysis for gDNA that was conducted on 1% agarose show Sharp bands for DNA isolated from buccal swab samples and there were no specific bands for any sample isolated from touch DNA Figure 1. The top-most layers of skin that constantly disposed of are the keratinized 'dead layer' which have lose their nuclei and have only small amounts of

fragmented DNA (21). Most common extraction methods utilized by researchers in forensic laboratories do not recover all collected DNA, with losses up to 75% occurring from chelex and organic extraction methods (22-24). Although our results show good quantities for DNA that extracted form touch DNA, they cannot show specific bands when analysis on agarose gel. This may reflect that DNA concentrations may be overestimated to varying degrees when assessed with the NanoDrop. Increasing the concentration of agarose gel may be required when extracted DNA have low quantities (20).

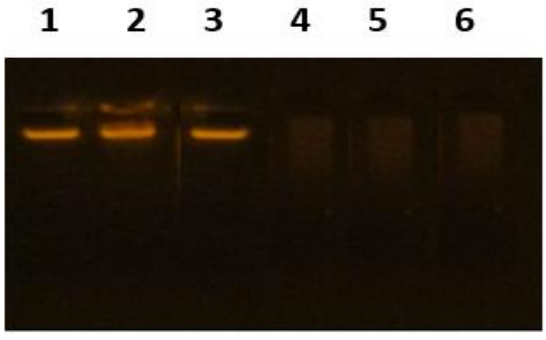

Figure 1: Gel electrophoresis analysis of genomic DNA on 1% agarose gel stained with red safe DNA dye and electrophoresed at 5 volt /cm for 45 minutes and visualized under UV light, lines (1-3) represent buccal swab samples and lines (4-6) represent touch DNA samples

STR marker loci (FGA and D5S818) were amplified by using specific primers and gel

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electrophoresis for analysis of PCR amplicons was conducted on 2% agarose. In this study fragment size of amplified FGA locus was (115-163 bp) and D5S818 locus was (308-464 bp) depended on repeat core in these loci in different individuals. PCR products for both FGA and D5S818 loci show faint bands for touch DNA samples when compared with samples that isolated from buccal swabs which appeared sharp specific band figure 2 and figure 3 respectively.

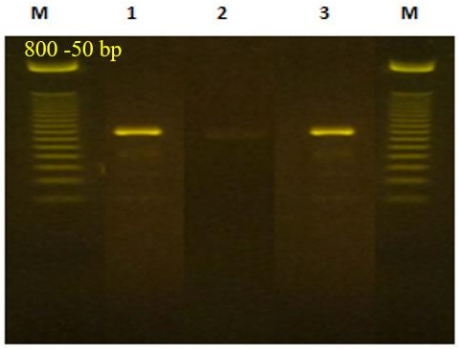

Figure 2: PCR product for FGA loci (line 1 represent buccal swab sample amplicon, line 2 represent touch DNA amplicon, line 3 represent repeat amplification of touch DNA amplicon, M represent marker DNA (800-50 bp)

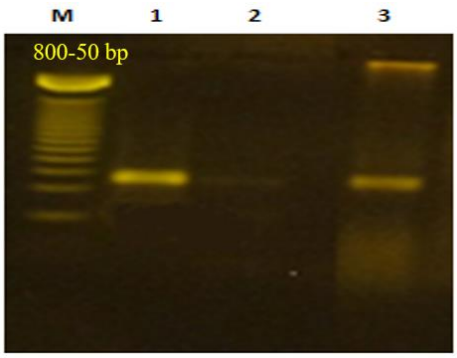

Figure 3: PCR product for D5S818 (line 1 represent buccal swab sample amplicon, line 2 represent touch DNA amplicon, line 3 represent repeat amplification of touch DNA amplicon, M represent marker DNA (800-50 bp)

Re-amplification for FGA and D5S818 amplicons with same thermal program that mentioned above appeared sharp specific bands which were identical to buccal swab samples when analysis on 2% agarose figure 3,4. The faint bands which result from first amplification may be related to low concentrations of touch DNA and the presence of inhibitors which make it difficult to obtain full DNA profile from such samples. Improving amplification for touch DNA either by repeated amplification, increasing cycle numbers during PCR, adding chemical adjuvant such as bovine serum albumin to increase reaction efficiency by preventing inhibitory substance from reduce the activity of Taq polymerase or by increasing DNA quantity through whole genome amplification (WGA) by replicating the entire DNA sample, rather than the specific target with PCR were recommended by several studies to facilitate increased STR profiling success (25-27).

Conclusion

Computers are widely used in the world, and now became a part of crime scenes. Forensic investigation of computers is focused on the digital information stored in the computers such as files, messages, pictures; calls sent and received which not indicate the user identity in crime scenes. Touch DNA that transferred from suspected through contacted with portable laptop can help in crime investigation. Even when the quantity of touch DNA is very low, full or partial STR profile can be obtain from such samples by improving the methodology of extraction and amplification.

References

1. Bright J, Petricevic SF. Recovery of trace DNA and its application to DNA profiling of shoe insoles. Forensic Sci. Int. (2004); 145: 7- 12.

2. Castella V, Mangin P. DNA profiling success and relevance of 1739 contact stains from casework. Forensic Sci. Int.: Gen. Suppl. Ser. (2008); 405-407.

3. Quinones I, Daniel B. Cell free DNA as a component of forensic evidence recovered from touched surfaces. Forensic Sci Int Genet. (2012); 6(1): 26-30.

4. Butler JM. Forensic DNA typing. Biology, technology and genetics of STR markers, 2nd ed., Elsevier Academic Press, Burlington, MA, (2005).

5. Gill P. Application of low copy number DNA profiling. Croatian Med J. (2001); 42: 229–232.

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6. Van Oorschot Ra, Ballantyne Kn, Mitchell Rj. Forensic trace DNA: a review. Investigative Genetics. (2010); 1: 14.

7. Rocque MJ, Leake SL, Milon MP, Castella, V. The Tightness of the Cotton Swabs Meshing Influences the Chances of Getting Conclusive DNA Profiles. J Forensic Res. (2014); 5: 1-5.

8. Meakin G, Jamieson A. DNA transfer: review and implications for casework. Forensic Sci Int Genet. (2013); 7: 434-443.

9. Lowe A, Murray C, Whitaker J, Tully G, Gill P. The propensity of individuals to deposit DNA and secondary transfer of low level DNA from individuals to inert surfaces. Forensic Sci. Int. (2002); 129: 25–34.

10. Lodhi KM, Grier R, Davis S, Phillips S, Lodhi MA. Generating human DNA profile(s) from cell phones for forensic investigation. J Forensic Res. (2015); 6: 288.

11. Sołtyszewski I, Szeremeta M, Skawrońska M, Niemcunowicz-Janica A, Pepiński W. Typeability of DNA in Touch Traces Deposited on Paper and Optical Data Discs Adv Clin Exp Med. (2015); 24: 437–440.

12. Tsai L, Chun-I Lee J, Lin Y, Lai P, Hsieh H. STR genotyping of skin residues inside gloves. Forensic Science Journal. (2010); 9: 1-8.

13. Thomasma M, Foran R. The Influence of Swabbing Solutions on DNA Recovery from Touch Samples, Journal of Forensic Sciences. (2013); 58: 465–469.

14. Sambrook J, Russel D. Molecular Cloning: A Laboratory Manual. 3rd edition. Vol. 3. New York, NY, USA: Cold Spring Harbor Laboratory Press; 2001.

15. Lowe A, *et al.* The propensity of individuals to deposit DNA and secondary transfer of low level DNA from individuals to inert surfaces. Forensic Sci. Int. 129 (2002); 25-34.

16. Phipps M, Petricevic S. The tendency of individuals to transfer DNA to handled items. Forensic Sci. Int. 168 (2007); 162-168.

17. Raymond JJ, *et al.* Trace DNA success rates relating to volume crime offences. Forensic Sci. Int.: Gen. Suppl. Ser. (2009); 136-137.

18. Castella V, Mangin P. DNA profiling success and relevance of 1739 contact stains from casework. Forensic Sci. Int.: Gen. Suppl. Ser. (2008); 405-407.

19. Goray M, *et al.* Investigation of secondary DNA transfer of skin cells under controlled test conditions. Legal Medicine 12 (2010); 117-120.

20. Sambrook J, Fritsch F, Maniatis T. Molecular cloning: a laboratory manual. New York: CSHL Press. (1989).

21. Kita T, *et al.* Morphological study of fragmented DNA on touched objects. Forensic Sci. Int. Genet. 3 (2008); 32-36.

22. van Oorschot RAH, Phelan DG, Furlong S, Scarfo GM, Holding NL, Cummins MJ: Are you collecting all the available DNA from touched objects? Int Congress Ser. (2003). 1239:803-807.

23. Frégeau CJ, Lett CM, Fourney RM: Validation of a DNA IQ™-based extraction method for TECAN robotic liquid handling workstations for processing casework. Forensic Sci Int Genet. (2010); 4: 292-304.

24. Côté A, Landry M, Rochette S, Gibson K, Lapointe M, Sarafian V: Automated DNA extraction from large volumes. Forensic Sci Int Genet Suppl Ser. (2008); 1: 22-23.

25. Dong H, Wang J, Zhang T, Ge J-y, Dong Y-q, Sun Q-f, Liu Ch, Li C-x. Comparison of preprocessing methods and storage times for touch DNA samples. Croat Med J. (2017); 58: 4-13.

26. Kreader CA: Relief of amplification inhibition in PCR with bovine serum albumin or T4 gene 32 protein. Appl Environ Microbiol. (1996); 62: 1102-1106.

27. van Oorschot RHR, Ballantyne KN, Mitchell RJ. Forensic trace DNA: a review.

Investigative Genetics. (2010); 1:14.

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عزل وتضخيم الحمض النووي التلامسي من الحاسوب المحمول

مريم جاسم شهاب مجيد ارشيد سباح ضحى سالم نعمة سرى نبيل

مركز الدنا العدلي للبحث والتدريب / جامعة النهرين / بغداد - العراق
Corresponding author: **miriam291083@gmail.com**

الملخص:

يعتبر تحليل الحمض النووي التلامسي من نماذج مسارح الجريمة فحصا اساسيا في المختبرات الجنائية. العديد من العوامل تؤثر على كمية الحمض النووي التلامسي المعزولة من السطوح المختلفة وبالتالي على نوعية التحليل النهائي. يهدف هذا البحث الى معرفة امكانية عزل كمية مناسبة من الحمض النووي من سطح الحاسوب المحمول لغرض التحليل الجنائي. تم تنظيف الحاسوب المحمول ومن ثم لمسه وجمع نماذج منه وعزل الحمض النووي باستخدام طريقة الاستخلاص العضوية ثم تم تضخيم تتابعات المواقع الوراثية STR الاكبر والاصغر حجما وهي على التوالي FGA (308-464bp) و D5S818 (115-163bp). اظهرت الدراسة الحالية امكانية عزل كمية مناسبة من الحامض النووي التلامسي وامكانية استخدامها للتحليل الجنائي حيث تم تضخيمها والكشف عنها بالترحيل الكهربائي. الحاسوب المحمول يعتبر مصدر مناسب للتحليل الجنائي.

الكلمات المفتاحية: الحمض النووي التلامسي، مسرح الجريمة، الحاسوب المحمول.