P- ISSN 1991-8941 E-ISSN 2706-6703
2020,14 (2):28-31

*Journal of University of Anbar for Pure Science (JUAPS)*

Open Access

# Degradation of DNA in Whole Blood and Semen by UV Radiation and High Temperature at Varying Time Lengths of Exposure

Miqat M. Mohsin and Dheaa Sh. Zageer*

Department of Chemistry, College of Science, Al-Nahrain University, Baghdad, Iraq

**ARTICLE INFO**

Received: 5 / 9 /2020
Accepted: 28 / 9 / 2020
Available online: 1 / 12 / 2020

DOI: 10.37652/juaps.2022.172372

**Keywords:**

DNA, degradation, Concentration, Purity, Temperature, UV visible



**A B S T R A C T**

The objective of this investigation was to study the effect of artificial ultraviolet (UV) radiation of varying wavelengths on the degradation of whole human blood DNA and semen over varying time lengths of exposure. DNA degrades rapidly when exposed to environmental factors like high temperature and UV-radiation. The extent of damage done to human DNA in relation to time of exposure to artificial UV and high temperature above 100°C that make blood samples unsuitable for forensic analysis has not yet been determined, and using two methods of extraction the organic and kit methods. The gel electrophoresis was used to appear the bands.

## 1. INTRODUCTION

DNA analysis has become a standard forensic technique used for investigating and solving a wide variety of crime (1). In forensic science, the biological samples encountered are often degraded and of low abundance. DNA degrades rapidly when exposed to various intensities of ultraviolet (UV) light (2, 3). Shorter wavelengths degrade DNA at a faster rate due to the higher amount of energy expended (4). There are three subtypes of UV rays, UVA (315–400 nm), UVB (280–315 nm) and UVC (100–280 nm) (4-6). UVA accounts for about 95% of the total UV energy that reaches the Earth ‘s surface, the remaining 5% being UVB (6). Though the shortest wavelength UVC, is absorbed by the atmosphere (6), it is used to sterilize equipment, tools and surfaces in hospitals and laboratory settings (3, 7). UVA can cause oxidative DNA damage, which can lead to gene mutation (8, 9). UVB, UVC and visible light cause damage to the DNA purine bases, guanine and adenine (8). Dimerization of adjacent pyrimidines, particularly thymine, is commonly regarded as the major effect of UV radiation (3). Dimerization distorts the DNA structure and results in low quantity of DNA. Therefore, if there is insufficient DNA a person cannot be identified (3, 10).

Deoxyribonucleic acid or DNA is a molecule that contains the instructions an organism needs to develop, live and reproduce. These instructions are found inside every cell, and are passed down from parents to their children. A complete set of genetic instructions is found inside virtually every human cell. DNA can be found in blood, semen, skin cells, tissue, organs, muscle, brain cells, bone, teeth, saliva, mucus, perspiration, urine, and even feces.

DNA extraction has three main steps:

1. Lysis of cell walls and membranes to release DNA into solution.
2. Purification of DNA by precipitating proteins and polysaccharides.
3. Precipitation of DNA and resuspension in a buffer.

The helical structure of double-stranded DNA is destabilized by increasing temperature. Above a critical temperature (the melting temperature), the two strands in duplex DNA become fully separated. Below this temperature, the structural effects are localized (11).

## 2. EXPERIMENTAL

Blood, seminal are obtained from one donor and deposited on a clean support (cotton) a stand and volume (200 µl) is applied on a piece of fabric and exposure to different

* Corresponding author at: Department of Chemistry, College of Science, Al-Nahrain University, Baghdad, Iraq; E-mail:: dheaairaqi72@gmail.com

temperature (30,60,100,200,250, and 300) for 1 hour. and exposure to UV visible for 1 hour, and after that extraction by using organic and Kit method.

## 3. RESULTS AND DISCUSSION

The effect of temperature on DNA extraction from blood and seminal samples of cloth was studied in the following table (1-1).

This result agrees with the study of the effect of fire on DNA and extreme heat on blood, seminal (12), no DNA were extracted from samples exposed to 100°C and the yield of DNA was significantly higher for all the samples that were not in direct contact of fire.

Table 1: Concentrations and purity of DNA isolated from cotton with seminal.

| Textile | Temp. degree | Con. | 230/260 | 260/280 |
|---|---|---|---|---|
| A-S | 30 | 37.5 | 1.6 | 1.5 |
| A-S | 60 | 37.2 | 1.5 | 1.3 |
| A-S | 100 | 35.8 | 1.3 | 1.4 |
| A-S | 200 | 30.3 | 1.2 | 1.3 |
| A-S | 250 | 31.2 | 1.3 | 1.1 |
| A-S | 300 | 31.8 | 1.1 | 1 |

**S:seminal A:cotton**

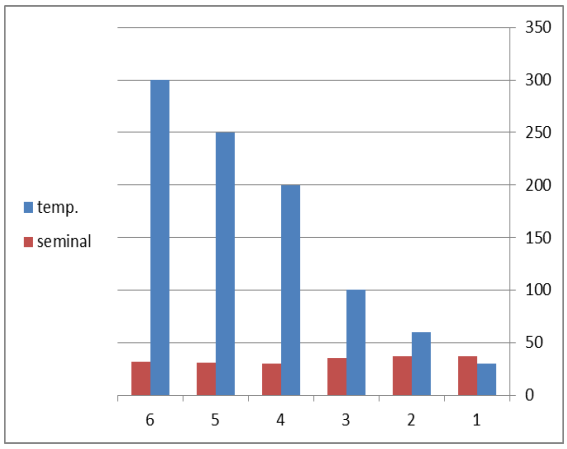


Fig:1: shows differences in bands intensities of DNA isolated from cotton with seminal.

Fig: 2: Gel electrophoresis of genomic DNA extracted from seminal samples. 1% agarose gel at 5 volt/cm for 30 ***minutes. Then visualized under UV after staining with eithidium bromide.***

Table 2: Concentrations and purity of DNA isolated from cotton with blood.

| Textile | Temp. degree | Con. | 230/260 | 260/280 |
|---|---|---|---|---|
| A-b | 30 | 35.1 | 1.2 | 1.3 |
| A-b | 60 | 34.6 | 1.6 | 1.5 |
| A-b | 100 | 33.1 | 1.4 | 1.1 |
| A-b | 200 | 33.8 | 1.1 | 1.2 |
| A-b | 250 | 30.1 | 1.1 | 1.1 |
| A-b | 300 | 29.9 | 1.2 | 1.2 |

**b:blood A:cotton**

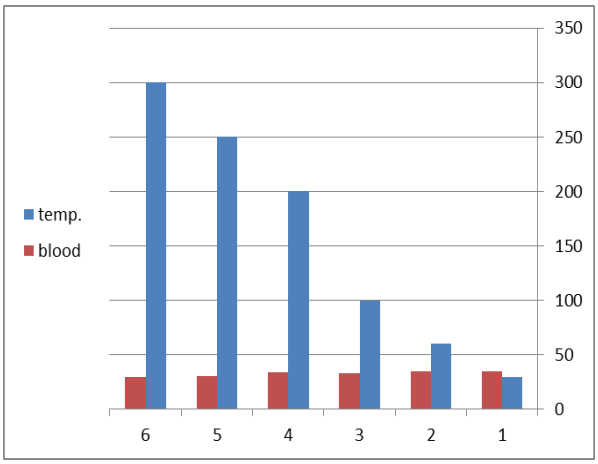


Fig:3: shows differences in bands intensities of DNA isolated from cotton with blood.

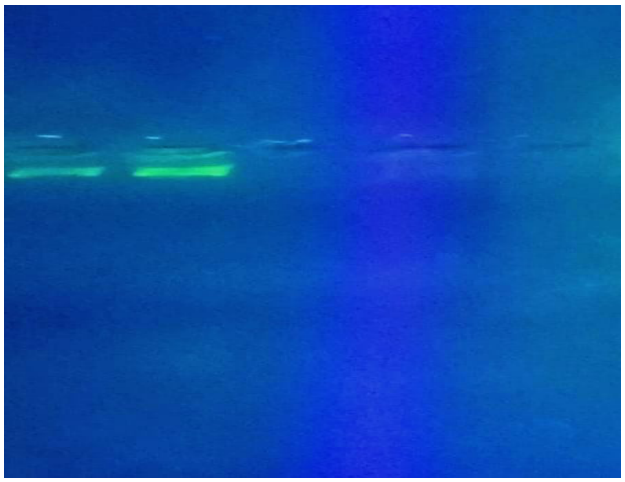

Fig.:4: Gel electrophoresis of genomic DNA extracted from blood samples. 1% agarose gel at 5 volt/cm for 30 minutes. Then visualized under UV after staining with eithidium bromide.

Study the effect UV radiation wave length was (240-280) during the time (one day, week, month) of blood and semen samples of cotton cloth.

This study agree with the study of the absorbance at 260 nm would increase with the degradation of DNA into oligonucleotides. (13)

Table 3: Concentrations and purity of DNA isolated from cotton with blood.

| Textile | UV | Con. | 230/260 | 260/280 |
|---|---|---|---|---|
| A-b | Day | 36.2 | 1.2 | 1.1 |
| A-b | Week | 33.4 | 1.6 | 1.3 |
| A-b | Month | 31 | 1.3 | 1.3 |

**A:cotton b:blood**

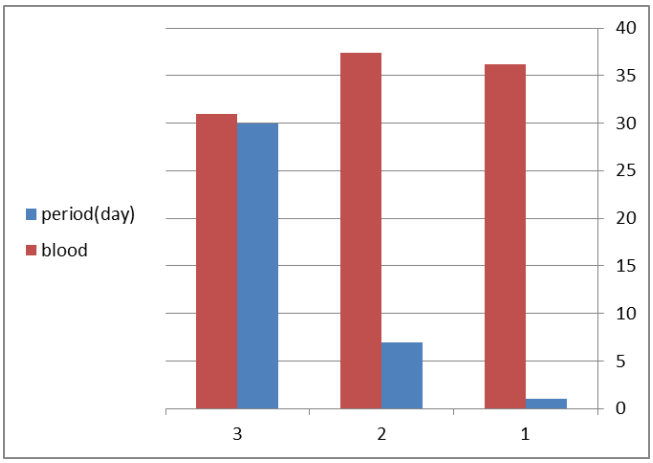


Fig: 5: shows differences in bands intensities of DNA isolated from cotton with blood.

Table 4: Concentrations and purity of DNA isolated from cotton with seminal.

| Textile | UV | Con. | 230/260 | 260/280 |
|---|---|---|---|---|
| A-S | Day | 35.5 | 1.3 | 1 |
| A-S | Week | 33.2 | 1.5 | 1 |
| A-S | Month | 32.5 | 1.1 | 1.1 |

**A:cotton S:seminal**

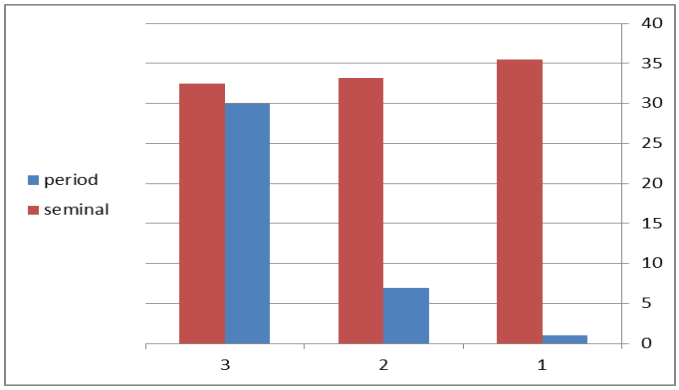


Fig: 6: shows differences in bands intensities of DNA isolated from cotton with seminal.

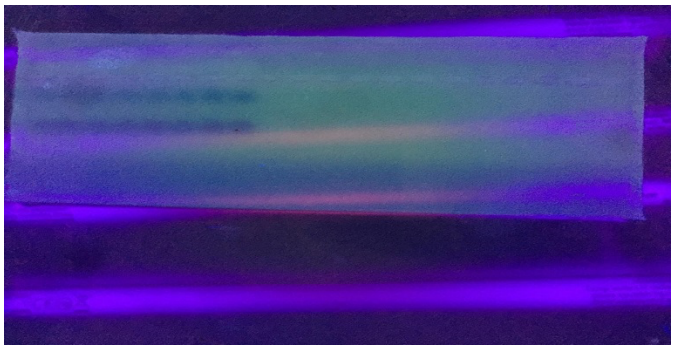

Fig: 7: Gel electrophoresis of genomic DNA extracted from seminal, blood samples. 1% agarose gel at 5 volt/cm for 30 minutes. Then visualized under UV after staining with eithidium bromide.

## 4.CONCLUSIONS

In forensic science the exposure DNA to high temperature above 100°C and UV-visible denaturant of DNA and decrease purity and concentration level.

**Acknowledgements**

Thanks to forensic DNA center for research and training lab where instruments were used for this study.

## REFERENCES

1. Bond J. W., and Hammond C.,2008 "The Value of DNA Material Recovered from Crime Scenes", Journal of Forensic Sciences (Wiley-Blackwell), 53, 797- 801,
2. Mitchell D., Paniker L., Lin K., and Fernandez A., 2015"Interspecific variation in the repair of UV damaged DNA in the genus Xiphophorus as a factor in the decline of the Rio Grande Platyfish", Photochemistry and Photobiology, 91, 486-492.
3. Gršković B., Dario Z, Maja P, Maja Jelena P, Dragan P, and Gordan M, 2013 "Effect of ultraviolet C radiation on biological samples", Croatian Medical Journal, 54, 263-271.
4. Georgieva M., Nikolova I., Bonchev G., Katerova Z., and Todorova D.,2015 "A comparative analysis of membrane intactness and genome integrity in pea, barley, and wheat in response to UVC irradiation", Turkish Journal of Botany, 39, 1008-1013.
5. Fuminari.U, Shinji.M, Yasunori.T, Yukihiko.H, Shuya Y, Mako.Y, Elena.E, and Yasunori.M, et al.,2014 "Comparison of UVB and UVC effects on the DNA damage-response protein 53BP1 in human pancreatic cancer", Journal Of Cellular Biochemistry, 115, 1724-1728.
6. Yagura T., Makita K., Yamamoto H., Menck C. F. M., and Schuch A. P.2011 "Biological Sensors for Solar Ultraviolet Radiation", Sensors (14248220), 11, 4277-4294.
7. Shah S., "Spectroscopic Analysis of Ultraviolet Lamps for Disinfection of Air in Hospitals", Water, Air & Soil Pollution Focus, 9, 529-537, 2009.
8. Nair-Shalliker V., Fenech M., Forder P. M., Clements M. S., and Armstrong B. K.,2012 "Sunlight and vitamin D affect DNA damage, cell division and cell death in human

lymphocytes", a cross-sectional study in South Australia, Mutagenesis, 27, 609-614.
9. Viki. S, Christina. A, Renny. S, Sandy. S, George. B, and Zalfa A. Abdel-Malek.,2014 "Significance of the melanocortin 1 receptor in the DNA damage response of human melanocytes to ultraviolet radiation", Pigment Cell & Melanoma Research, 27, 601-610.
10. Bright J. A., Taylor D., Curran J. M., and Buckleton J. S., 2013"Degradation of forensic DNA profiles", Australian Journal of Forensic Sciences, 45, 445-449.
11. Peters J. P., and Maher L. J., 2010 "DNA curvature and flexibility in vitro and in vivo", Q. Rev. Biophys., 43, 23−63.
12. Kumar N., Chauhan A., and Gupta R., 2019"Effect of Fire on DNA and its profiling in homicide cases", Forensic Res Criminol Int J, 7, 90-94,
13. Sambrook J., and Russell D. W.,2001 "Molecular Cloning: A Laboratory Manual", New York, Cold Spring Harbor Laboratory Press.

# تدهور الحمض النووي في الدم الكامل والسائل المنوي عن طريق الأشعة فوق البنفسجية وارتفاع درجة الحرارة عند فترات زمنية متفاوتة من التعرض

ميقات محمد محسن و ضياء الشيخ زاجر

قسم الكيمياء - كلية العلوم - جامعة النهرين - بغداد – العراق

الخلاصة:

كان الهدف من هذا التحقيق هو دراسة تأثير الأشعة فوق البنفسجية الاصطناعية بأطوال موجية متفاوتة على تدهور الحمض النووي للدم البشري الكامل والسائل المنوي على فترات زمنية متفاوتة من التعرض. يتحلل الحمض النووي بسرعة عند تعرضه لعوامل بيئية مثل ارتفاع درجة الحرارة والأشعة فوق البنفسجية. لم يتم بعد تحديد مدى الضرر الذي يلحق بالحمض النووي البشري فيما يتعلق بوقت التعرض للأشعة فوق البنفسجية الاصطناعية وارتفاع درجة الحرارة فوق 100 درجة مئوية مما يجعل عينات الدم غير مناسبة لتحليل الطب الشرعي. وباستخدام طريقتين للاستخراج العضوي و Kit method. تم استخدام الترحيل الكهربائي للهلام لإظهار قطعه من الحمض النووي.