

Forensic DNA Analysis and the Importance of DNA Analysis in the Turkish Legal System

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ABSTRACT

Biological evidence is a type of evidence, which perpetrators do leave behind, coincidentally most of the time, no matter how careful they are, and can be detected despite the cleaning of the crime scene. The generation of the genetic profile of a person through DNA analysis of biological evidence has been a revolutionary development in the resolution of criminal cases. DNA analyses are effectively used in the resolution of criminal cases, the determination of genealogy, disaster victim identification and exoneration of people sentenced for a crime they did not commit. The logic behind forensic DNA analyses is the fact that the DNA molecule areas examined are 'unique' in every human being in the world. Within the scope of the Turkish Criminal Procedure Code, which was put into practice in 2005, arrangements have also been made as to molecular genetic examination in investigation of crimes.

ÖZET

Biyolojik deliller suçu ne kadar dikkatli olursa olsun çoğu zaman bırakıldığı için farkına varılmayan hatta ortam temizlense dahi tespit edilebilen delil türüdür. Bu delillerin DNA analizi ile incelenerek kişinin genetik profilinin tespit edilmesi adli olayların aydınlatılmasında devrim niteliğinde bir gelişme olmuştur. DNA analizleri, kriminal olayların çözümlenmesinin yanı sıra soybağının tespitinde, çok sayıda kişinin

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öldüğü felaketlerde kimliklendirme çalışmalarında ve işlemediği suçun cezasını çekenlerin masumiyetlerinin ortaya çıkarılmasında etkin olarak kullanılmaktadır. Adli DNA analizlerinin temel mantığı DNA molekülünün incelenen bölgeleri yönünden dünyadaki her insanın “eşsiz” olmasına dayanmaktadır. Türkiye’de 2005 yılında yürürlüğe giren Ceza Muhakemeleri Kanunu kapsamında, suç araştırmalarında moleküler genetik incelemelerle ilgili düzenlemeler de yapılmıştır.

Keywords: *Biological evidence, crime scene investigation, DNA, forensic DNA analysis, Criminal Procedure Code.*

Anahtar Kelimeler: *Biyolojik deliller, olay yeri incelemesi, DNA, adli DNA incelemeleri, ceza muhakemesi kanunu*

Biological Evidence

One of the best known concepts of crime investigation is the Locard Theory, which can be summarized as ‘every contact leaves behind a trace’. As a matter of fact, during the commission of a crime, even if the criminal pays special attention not to incriminate him or herself, he or she comes definitely into contact with other persons affected by the crime, the environment and objects in the environment. Thus, various types of material are transferred between persons, from a person to a crime scene and vice versa. This material can be big enough to be seen with the eye or latent, thus so small that it can only be made visible with special techniques. Especially in cases of manslaughter, sexual assault and burglary there is definitely contact between persons and the environment. For instance in sexual offenses, except for an unconscious victim or a victim unable to resist for whatever reason, there is definitely a fight between victim and perpetrator. Even if the assailant does not leave sperms behind, it is possible to find skin tissue in the finger nails, and hair between the fingers or on the body of the victim. In the same manner, after a murder incident, even if the perpetrator cleaned the blood, latent blood stains would be located with special methods and the genetic ID of the assailant be determined. As can be understood from these examples, it is virtually impossible not to leave behind any biological evidence, so long as the expert knows where to find what type of stain based on the type of crime^{1, 2}. The basic purpose of crime scene investigation is to find and collect evidence by using special techniques depending on the type of material and to establish the relationship between

¹ SH. JAMES, JJ. NORDBY: **Forensic Science-An Introduction to Scientific and Investigative Techniques**, CRC Press, Boca Raton 2003.

² AYŞİM TUĞ, HAMİT HANCI: “Cinayet Olgularında Olay Yeri İncelemesinin Önemi”, **Cumhuriyet Bilim Teknik**, 15.10.2001.

crime, crime scene and people by conducting the appropriate laboratory examinations.

The main samples used for examination and defined as biological evidence are the following:

- Blood /blood stain
- Semen/semen stain
- Saliva / saliva stain
- Vaginal fluid / stain
- Amniotic fluid /stain (the fluid in the sac holding the fetus)
- Meconium/stain (the dark green – black content of the intestine of the baby emptied after birth)
- Head and body hair
- Sweat
- Bones
- Teeth
- Soft tissue samples
- Abortion material³

Due to degradation because of heat, humidity and similar environmental factors biological evidence is one of the first to be retrieved from the crime scene. The samples collected with the proper methods are examined with specific techniques to determine the material type and the living thing they belong to. If the material belongs to a human being, the person's gender and genetic ID can be determined through genetic examinations.

Genetic Examinations for Identification

The scientific reason for using biological samples in forensics is the fact that the genetic characteristics of a person are transferred from the mother and the father by inheritance.

One of the hereditary characteristics is blood types. The serum proteins and red blood cell enzymes of many blood types led by AB0 and Rh have been used for many years to identify a person. However, studies have shown that neither

³ B.A.J. FISHER: **Techniques of Crime Scene Investigation**, CRC Press 1993 (5th Edition), pp. 8 – 25.

of these characteristics alone sufficed to ultimately eliminate a person or prove their connection to a crime. In a study aimed to determine the distribution of blood types in Turkish society, 43,2% of people were blood type A, 16,2% were blood type B, 7,6% were blood type AB and 33% were blood type O. Thus, it would not be possible to rely just on the blood type to discriminate between individuals, because there are many people with the same blood type. So, after determining the blood type from a crime scene sample in a case, even though it is possible to eliminate suspects with other blood types, if there is more than one suspect with the same blood type, it will not be enough to identify the actual perpetrator⁴.

A vital decision, such as, whether or not a person is guilty, is based on the results of the analyses of biological samples. That is why making use of as many discriminatory characteristics as possible to identify a person has become a necessity. This approach has given rise to forensic seriology applications with blood and other body fluids in the past. Identification over the serum proteins and red blood cell enzymes in the blood of many types has led to 93% discrimination⁵. While studies continued to further raise this rate and to reduce faults in the discrimination between perpetrator and innocent, in 1985 a rape and murder offence resolved by means of DNA analysis has led to a radical development in forensic sciences.

In what has been accepted as the beginning of the use of DNA analyses in forensic sciences and called the 'Pitchfork Case' in literature, the blood type of the perpetrator was identified from his sperm found in the body of a young woman who was raped and murdered. However, due to the lack of any other piece of evidence, which would have led to the detection of the suspect, the case could not be resolved. A short time after that, in a second murder incident of a young woman, the blood type of the assailant was found to match the one in the first case. British police have detained Richard Buckland as the suspect of the crime, because he knew certain characteristics of the body of the second woman, but in order to establish a more conclusive link between this person and the two crimes, help was requested from British geneticist Alec Jeffreys, whose DNA analysis studies had been published. Jeffreys found the DNA profiles of the assailant and Buckland did not match, proving the innocence of Buckland. In order to solve the crime, blood samples from 5000 men living in the area were taken, and the six-month-long analysis did not result in a match.

⁴ NURETTİN BAŞARAN: **Tıbbi Genetik**, Güneş & Nobel Tıp Yayınevleri, Ankara, 1999 (7. Basım), ss. 354 – 355.

⁵ BERNARD KNIGHT: **Simpson Adli Tıp**, Bilimsel ve Teknik Yayınları Çeviri Vakfı, İstanbul 1995, ss.57-64

Nevertheless, upon learning that instead of a person called Colin Pitchfork another one submitted his blood sample, Pitchfork had to give a sample from his blood, and because his DNA profile matched the assailant's, he was arrested^{6, 7}. After this incident DNA analyses have been embraced by scientific and legal circles very soon and became routine techniques of examination. Thanks to this method, many cold cases could be resolved, which led to progress in the fight against crime.

The methods used in the first years were developed soon and DNA Analysis on nanogram grade samples, which is one billionth of a gram, with Polymerase Chain Reaction (PCR) has become possible. New developments in the techniques have made samples such as hair without a root, which were useless in the past, workable⁸. Furthermore, the time to examine casework became shorter, dropping from weeks down to days and even hours.

Forensic DNA analyses today are used to

- solve criminal cases,
- detect paternity and affiliation,
- identify disaster victims, the number of which can be very high
- prove the innocence of people wrongfully convicted of crimes they did not commit⁹.

The Scientific Basis of Forensic DNA Analyses

DNA (Deoxyribonucleic acid) is a genetic molecule carrying all the information of being, needed for development and functions. In forensics two types of DNA sources are used.

1. The nuclear DNA

found in the nucleus of all cells and constituting the chromosomes

2. The mitochondrial DNA

⁶ A.J. JEFFREYS: "Individual Specific 'fingerprints' of Human DNA", *Nature* –316 (6023),1985; pp. 76–79.

⁷ <www.bbc.co.uk/crime/caseclosed/colinpitchfork.shtml> Erişim: 10.08.2005

⁸ G.F. SENSABAUGH, C.V. BEROLDINGEN: "The Polymerase Chain Reaction: An Application to the Analysis of Biological Evidence" in *Forensic DNA Technology*. (Eds. M.A. FARLEY and J.J. HARRINGTON), Lewis Publishers, New York 1991; pp. 66 – 78.

⁹ M.A. JOBLING, P. GILL: "Encoded Evidence: DNA in Forensic Analysis", *Nature*, Vol. 5(10); 2004, pp. 739-751

from the mitochondria found outside the nucleus of cells⁽⁹⁾

These two DNA differ from each other structurally. Nuclear DNA is in the linear form, which codes information such as the physical characteristics and genetic diseases of a person, while a major part of it is non-coding. In forensic DNA analyses the non-coding areas are examined, because these can show differences in each individual except in identical twins without any phenotypical changes. In other words, the profile obtained by analyzing these areas is like the barcode of a commercial product making a person unique among billions^{10, 11}.

Since the basic aim of forensic DNA analysis is to discriminate between persons, the DNA profile is considered to be the most reliable criteria serving that purpose. Mitochondrial DNA (mtDNA) has a round shape. Today's forensic studies analyze one part of it called control region, which varies greatly from human to human. Moreover, while nuclear DNA is a single copy, mtDNA has hundreds of copies in each cell. In degraded, burnt or old samples and hair without root, which cannot yield any results with nuclear DNA analysis, mtDNA can generate a profile due to protection provided by its ring structure and its high quantity. These two types of DNA are different in their type of inheritance. Nuclear DNA transfers characteristics from both the mother and the father, while mtDNA is transferred only from the mother (maternal inheritance). Thus all generations springing from the same mother carry the same mtDNA characteristics. This is very helpful to "trace back the forefathers of man" in anthropological studies such as mapping the distribution of human beings in the world. However, due to maternal inheritance, in forensic cases a match between the crime scene sample and the mtDNA reference sample from the suspect will cover not only the suspect but also other female relatives of the suspect from the mother's side. Even so, in cases where there are lots of suspects, it can be accepted as a very important technique because it narrows down suspects. Furthermore, if an unidentified body remain is found, in very old samples, which cannot yield results with nuclear DNA analysis, or if blood relatives cannot be found, mtDNA provides the opportunity to compare with maternal relatives^{12, 13}. MtDNA analysis, which is carried out with a different technique

¹⁰ L. CAREY, L. MITNIK: "Trends in DNA Forensic Analysis", *Electrophoresis* – 23 (2005), pp. 1386 – 1397.

¹¹ N. RUDIN, K. INMAN: *An Introduction to Forensic DNA Analysis*, CRC Press, Boca Raton 2002, pp. 17 – 26.

¹² S, LUTZ, H.J. WEISSER, J. HEIZMANN, S. POLLAK.: "DNA as a Tool for Identification of Human Remains", *Int. J. Legal Med.*, 109 (1996), pp. 205 – 209.

from the one applied in nuclear DNA analysis, also lasting longer, is performed at few centers in the world. In Turkey, mtDNA is carried out at Ankara University's School of Medicine, Forensic Medicine Department and has been used in the resolution of certain cases two of them being inheritance disputes.

Another identification method used in forensic studies in recent years is the Y-STR analysis. It has been found that on the Y chromosome, only present in males, there are gene areas with a very significant discriminatory power in the population. The DNA analysis defined as Y-STR is particularly helpful in the resolution of rape cases. In rape cases with a female victim, cells in the vaginal sample taken from the woman suppress the male sample. In such cases it is possible to copy and analyze only the male DNA with Y-STR. In rape committed by more than one offender this method makes it easier to differentiate between the offenders. Thus, the actual rape offender and the maliciously accused ones can be separated. If in paternity suits, in which the child is male, the father is not known, since the Y chromosome is the same in male paternal relatives, it is possible to compare the Y-STR areas of the child with the ones of the mentioned relatives. As does mtDNA, Y-STR covers not only a single person but also people from the same line. It also narrows down the number of suspects and is conclusive when considered together with other pieces of evidence in the establishment of the relationship between the offender and the crime.¹⁴

In sexual offences very special studies are conducted with DNA analysis. It is possible to take a small amount of the amniotic fluid in the fetus with the growing infant by means of special techniques and determine the lineage/genealogy in early terms of pregnancy through DNA analysis. This method is particularly important for the decision on legal termination of pregnancy induced by rape.

One of the other important incidents resolved by DNA analysis is the identification of disaster victims. Natural disasters, big explosions, fire, transport accidents, terror events, mass graves from genocides are defined as disaster in international literature. In events like these, the place and time of which cannot be foreseen, many people die at the same time and their bodies generally change beyond recognition. Identification of the dead as soon as possible and in an accurate manner is vital from the human, religious, social and legal points of view. This is why identification is carried out by special teams

¹³ M.R. WILSON, J.A. DIZINNO, D. POLANSKEY, J. REPLOGLE, B. BUDOWLE: "Validation of Mitochondrial DNA Sequencing for Forensic Casework Analysis". *Int. J. Legal Med.*, 1995; Vol. 108 (1995), pp. 68 – 74.

¹⁴ SH. JAMES, JJ. NORDBY (2003); L. CAREY, L. MITNIK: "Trends in DNA Forensic Analysis", *Electrophoresis* – 23 (2005), pp. 1386 – 1397.

comprising scientists from different disciplines and security forces. They try to identify the dead from their fingerprints, teeth records kept by dentists, personal jewellery and effects, surgical scars and birth marks on the body. If these do not yield any results, or if they are not conclusive, DNA analysis is conducted for definite results¹⁵.

Another issue resolved by DNA analysis is the exoneration of a wrongfully convicted people. During a project study launched in the USA in 1992 it has become obvious that especially in rape and manslaughter cases biological evidence was not evaluated in the proper manner, instead witness statements were deemed sufficient to convict. Within the frame of the project, the most important criterion for retrial was found to be the existence of biological evidence. Research made by prosecutors, lawyers, law and journalism school students make it possible to reopen trials and exonerate people by means of DNA analysis, in cases with existing but neglected or not examined biological evidence due to the lack of technical means at that time¹⁶. This project, which is legally and financially supported by the US government, has raised the number of exonerated people to 170 by September 2005. Since DNA analysis made it possible to exonerate people, the majority of whom was imprisoned to at least ten years, the project is known as ‘the project of people accused by the jury, but exonerated by science’.

Genetic Examinations in the Turkish Law

Turkey makes use of every technological development in the resolution of criminal cases. A result of this approach is the incorporation of molecular genetic examinations in the Criminal Procedure Code adopted in 2005. The new law emphasizes methods to fight crime which include collection of evidence of scientific value in compliance with international law and human rights.

Articles 75 and 76 of the Criminal Procedure Code define under what kind of conditions and by whom biological samples can be retrieved:

a) If the crime is punishable by less than two years imprisonment, physical examination shall not be carried out and biological samples shall not be taken from the body.

¹⁵ Mustafa Güler, **Hekimler ve Tabip Odası Yöneticileri İçin Mevzuat**, Türk Tabipler, Birliği Merkez Konseyi Yayınları, 3. baskı, ss. 106-108.

¹⁶ AYŞİM TUĞ: Masumiyet Projesi: Bilimin Akladığı İnsanlar. Adli Bilimler Dergisi 4(3):2005, ss. 33-41.

b) The public prosecutor, judge or court need to authorize the taking of blood, vaginal secretion and sperm samples from the body of the suspect or defendant to obtain evidence in a crime.

c) Samples can only be taken by a physician or a health personnel under the supervision of a physician, if there is no threat to the person's health.

d) Next to samples like blood and vaginal secretion, which are taken by (invasive) methods violating the physical integrity of a person, hair, saliva and nail samples can be taken by instruction of the public prosecutor. However, unless the decision of the prosecutor is upheld by a judge or court within twenty-four hours, the evidence obtained cannot be used.

Samples taken under the above conditions are used to determine the link between a person and a crime or to identify a person by being compared with crime scene samples. Articles 78, 79 and 80 governing molecular genetic examinations, stipulate when and by whom molecular examinations can be carried out, and the terms of confidentiality related to the analysis results:

a) DNA analysis shall solely be carried out to determine whether or not samples belong to a suspect, a defendant or a victim, or the genealogy, or to generate a genetic profile from found and unidentified human remains.

b) A judicial decision shall be required for genetic examinations.

c) The examiner shall be mentioned in the judicial decision.

d) The expert must be officially appointed by judicial decision or must fulfill the obligation arising from being an expert, or not be a member of the investigation or the prosecution office, or come from a separate organizational unit than the investigation or prosecution office to maintain objectivity.

e) The analyzing expert shall not be given any personal information about the owner of the sample material they examine.

f) This information is personal. This is why the expert is obliged to ensure confidentiality of information.

g) This information shall on no account be used for the investigation of another crime.

h) The results of the analyses shall be destroyed by way of protocol in the presence of the public prosecutor, if a decision not to prosecute is delivered,

after the deadline for objection to that decision, or at the latest within ten days, if the objection is rejected or the judgment becomes final.^{17 18}

Forensic DNA analysis in Turkey is carried out by the Forensic Laboratory of the General Directorate of Security affiliated to the Ministry of Interior, the Forensic Laboratory of the General Command of the Gendarmerie, the Forensic Medicine Institution affiliated to the Ministry of Justice and in some universities run by a sovereign body called the Higher Board of Education (YÖK). The quality of work of DNA experts working in these organizations depends on the retrieval of the proper samples in sufficient quantity and their transportation to the laboratory under the appropriate conditions. Thus, security forces and the physician taking the biological sample need to have sufficient information and experience as do DNA experts. Biological samples are part of the crime scene investigation training curriculum. However, it is gravely important for physicians taking samples from the human body to know about this issue, too.

Another link between legal practice and DNA analysis lies in the concept of ‘repetition of crime’. Various studies have shown that people, who have committed serious crimes, have been committing minor ones in the past, and that people having served their sentence committed crimes within three months of their discharge from prison^{19,20,21}. The repetition of crimes by perpetrators has a higher significance for Turkey, a country, which has issued many amnesty bills. One of the most efficient sources of establishing the link between crime, perpetrator and crime scene is the DNA databank. In many countries the DNA data of perpetrators of specific offences are retained electronically, being the first compared against crime scene samples during the investigation of crimes²². In Turkey, organizations carrying out DNA analysis have their own respective DNA databases, and although by integrating these data crime could be

¹⁷ **Ceza Muhakemesi Kanunu**, Türkiye Cumhuriyeti Adalet Bakanlığı Yayın İşleri Dairesi Başkanlığı Yayını, Ankara Açık Cezaevi Matbaası, Ankara 2005, ss. 51 – 56.

¹⁸ **Ceza Muhakemesi Kanunu**, Türkiye Cumhuriyeti Adalet Bakanlığı Yayın İşleri Dairesi Başkanlığı Yayını, Ankara Açık Cezaevi Matbaası, Ankara 2005, ss. 51 – 56.

<http://www.ceza-bb.adalet.gov.tr/>

¹⁹ <http://www.ceza-bb.adalet.gov.tr/mevzuat/cmkgerekce.doc>

²⁰ In Minor Crimes Yields Major Benefits in Public Safety <http://www.ncjr.org/pdf/files/20.08.2005>

²¹ <http://www.fbi.gov/hq/lab/org/dnau/html> 05.11.2005

²² J.E. McEWEN: “Forensic DNA Data Banking by State Crime Laboratories”, **Am. J. Hum. Genet.**, Vol. 56, Issue 6 (1995), pp. 1487

combated more efficiently, implementation requires the data to be destroyed, which will be an obstacle in front of the creation of a DNA databank in Turkey.

The detection of the actual criminal by way of scientific evidence and the provision of the crime-punishment balance will build up trust in the legal system and contribute substantially to social peace.