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## The Importance of Molecular Genetic Examination in Crime Investigation

*The essence and the contents of molecular genetic examination are revealed, its definition is provided, the importance of this examination is stressed, and the examples of molecular genetic examination in foreign countries and in Ukraine are presented.*

**Keywords:** molecular genetic examination, method of identification, DNA analysis, the objects of biological origin.

In solving of particularly serious types of crimes in the world practice, an important role has always been devoted to working with the traces of biological origin. Over the past decade, the expertise of these traces has been further developed, primarily due to the application of genetic and molecular biological methods of research that can identify traces of a particular person, as well as to establish the heredity of certain genetic features of a person. The identification method based on DNA analysis – a method of DNA analysis has received significant development in forensic medical research.

The uniqueness of this method is the ability to investigate even small amounts of biological material, which is especially important in cases where ultra traces (single hair, blood splatter or semen) remain at the crime scene.

The material basis of the individuality of any biological object is its genetic material. It is present in virtually any cell in the body. All properties (attributes) of the organism are genetically determined.

Theoretically, the molecular genetic identification method is the most universal, since it can, in principle; identify any objects of biological origin if they retain DNA molecules.

Using highly effective technical means, you can get a result with the probability of less than a few billion cases. That is to find a single person from all who live on the Earth. Versatility and high individualization of results make this method the most promising

among all other methods of human identification in the cases of direct study of the objects of biological origin.

The ability to study the DNA molecule is based on the individuality of the structure of some of its sites. The structures of these sites are not only individual in each person, but also repeated in all organs and tissues of one person, which allows identifying all kinds of biological objects: blood, semen, muscle tissue, bones and hair.

Due to the achievements of genetics, immunology, biochemistry, this section of forensic medicine is developing successfully. In this regard, the modern level of forensic examination of the material evidence of biological origin is constantly changing. In view of this, a number of traditional sections of the examination of the material evidence need new, modern coverage, interpretation and popularization.

In recent years, the method which allows studying very small amounts of destroyed DNA molecules has been developed and actively implemented in expert practice. With the introduction of the practice of such a modification of molecular genetic examination, one of the most significant obstacles to the practical forensic medicine use of the method, which was the limited material necessary for conducting a successful study, in terms of volume and quality, were eliminated.

Undoubtedly, the use of molecular genetic examination can solve many problems arising in solution and investigation of crimes.

However, one of the tasks in solution and investigation of crimes in the absence of an offender (in case of serial rape) is the possibility to return to the «old» biological traces, that is, recovered long before the suspect was identified, and identify the offender for them. Therefore, it is very important that the data obtained in the genetic study, was stored in the database for their possible further comparison.

In 1985–1987 the English scientist A. Jeffries and his co-authors managed to identify mini-satellite DNA, which is located at once in several chromosomal loci. The overall structure of the mini-satellite DNA was individual for each person; therefore, it was proposed to use the identified sites for the identification of a person in forensic medicine [1, p. 6].

Molecular genetic examination is an individual identification (a unique genetic passport), the establishment of blood relationship at the level of the study of the structure of deoxyribonucleic acid (DNA). This type of examination allows not only categorically exclude paternity, but also the positive establishment of both parents and

blood relationship in general (identification of a person), as well as the diagnosis of hereditary diseases in the fetus in the early stages of pregnancy [2, p. 198].

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 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 results [3, p. 106–108].

Molecular genetic analysis makes it possible:

- to establish the fact of a blood relationship between individuals;

- to make concrete conclusions regarding the affiliation of the traces of the individual of a particular sex;

- to investigate traces that contain a small amount of the biological material, traces of blood that have undergone a rotten change and are inaccessible to other types of research;

- to differentiate mixed traces;

- to identify unidentified persons (including parts of the corpse) in the presence of supposed relatives;

- to establish the circumstances of the accident with a large number of victims;

- in the absence of persons suspected of committing serious crimes, to receive and store genetic maps of the traces on the material evidence with subsequent identification in the database [4, p. 35].

To date, in many Western countries, the accumulated experience of molecular genetic identification of living persons and corpses is being used more and more frequently.

Thus, in New Jersey, the Department of DNA analysis has an average of 2500 examinations per year, of which 120 – with the study of mitochondrial DNA. Nearly 30 000 DNA-profiles of samples

of convicts for different categories of crimes are handled annually and sent to the FBI's CODIS program. For the needs of the department, there are 12 genetic analyzers and 3 automated biorobots that significantly shorten the time and minimize manipulations that are carried out by the expert manually [5, p. 23].

In the FBI Central Virginia Laboratory, the first examinations with the use of mtDNA were performed in 1992. In 1995, the validation phase of the relevant procedures was followed, and in 1996, such a first criminal case was judged. To date, examinations of about 1000 criminal cases are conducted annually in the mtDNA Research Department. Expertise is carried out in two directions: 1 – investigation of the biomaterials for criminal cases; 2 – replenishment of the national database of DNA samples of relatives of missing persons and unidentified corpses.

In Scotland, with a population of 5 million, an array of DNA databases is 170 000 DNA profiles of individuals and 70 000 traces recovered from the places of unsolved crimes. Every week, one employee enters 180–200 DNA profiles in the database.

The database also records the corpses' DNA profiles, who are not identified, as well as the police officers, who are directly involved with the identification and the recovery of material evidence (with the aim of their further exclusion in the case of improper handling of recovered objects or accidental contact with biological isolation of police officers with real evidence).

DNA profiles of unidentified persons for further verification are sent to the national database, where the duration of the inspection is 2–3 days.

Every month, 250–300 matches of DNA profiles are obtained from the database, about 10 % of which contribute to the disclosure of crimes [6, p. 23].

In France, the bank of DNA profiles is formed from DNA profiles of persons who committed crimes (convicted), which consists of 30 000 DNA profiles.

The legal basis for the functioning of the bank is the relevant law passed in 1998. By law, March 18, 2003, amendments were made to expand the scope of the use of DNA, the selection of DNA profiles for persons suspected of committing crimes is provided for, as well as the creation of a database of DNA isolated from the objects of biological origin recovered at the crime scene.

The extraction of DNA profiles is carried out by five scientific and technical police laboratories, a gendarmerie laboratory, a number of private laboratories (the main laboratories: the Laboratory of the Center for Scientific and Technical Police in Lyon and the laboratory of the gendarmerie), which send DNA codes of isolated DNA profiles to the National Bank (specimens DNA are stored in gendarmerie units in special storage facilities).

For the extraction of DNA profiles, saliva is selected separately from the left and right cheeks and is applied by wetting method to special paper attached to a unique card (it has its own number), which is imprinted with the index finger of the left and right hands respectively, as well as specify place, date. Selection of saliva is carried out at the crime scene or at the police station by a specialist or police officer.

At the request of a police officer investigating a crime, an expert judgment is appointed by the court, which instructs it to conduct with a laboratory of the corresponding profile at its discretion. According to the results of the examination, the information about the selected profile is sent to the bank of DNA, and the result of the examination is sent to the police officer.

DNA-based tests can also be conducted at the local level (in specialized laboratories), but only the results of the National DNA Data Bank's check are officially recognized.

The conclusion of the DNA examination is based on the results of laboratory studies and inspections of the data bank (in essence, the expert evaluates the result of the DNA data bank audit).

The verification of received DNA profiles in the data bank lasts from 24 to 72 hours. The results of the audit are reported only in writing (it is permissible to transmit the relevant information by fax). The comparison of each DNA profile is carried out in all array of data bank [7, p. 162–163].

According to British forensic experts, with the help of the DNA database created by them, which currently contains information about approximately 500 000 genotypes, every fourth criminal offense is now disclosed, according to which the genetic material is recovered from the crime scene. As a result of using the DNA database (in fact, genetic criminal record) in Great Britain it has allowed to significantly increase the percentage of solving, as well as reveal cases that were considered long unpromising [8, p. 38].

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. 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. 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 [9].

The 124<sup>th</sup> Central Laboratory of Medical Forensic Identification (CLMFI) of the Ministry of Defense of Russia provided an opportunity to establish the identity of corpses that remained unidentified for a long time. The Federal Target Program of Russia for strengthening the Combating Crime for 1994–1995, approved by the Decree of the President of the Russian Federation dated May 24, 1994, No. 1016, and then for 1996–1997, was supposed to create a «genetic-dactyloscopic record» in Russia. At that time, 15 expert laboratories of DNA analysis were created in the Expert-Forensic Units of the Internal Affairs bodies of the Russian Federation (Altai, Krasnodar and Khabarovsk districts, Samara, Tomsk, Belhorod, Novhorod and other regions) [8, p. 38].

In Ukraine, since 1994, the expertise is carried out using the method of DNA analysis. The only data bank is in the department of biomedical expertise of the State Scientific Research Forensic Center (SSRFC), which has about 300 samples, recovered from the scene of undetected crimes [10, p. 93–96].

Thus, with the help of biomedical examinations on the establishment of DNA profiles of the objects of biological origin, conducted by the SSRFC of the Ministry of Internal Affairs of Ukraine and the regional Bureau of Forensic Medical Examinations (BFME), a significant number of serious crimes were solved: for example,

rape of a minor in the city of Cherkasy, the murder of rape in Simferopol and other serious crimes committed in Chernivtsi, Zhytomyr, Donetsk, Zaporizhia, Rivne and other oblasts.

A typical example is the solving of a serious crime committed in the city of Vinnytsia. On the morning of January 9, 2001 on the territory of kindergarten was found corpse of N., with signs of rape and strangulation.

The investigator of prosecutor's office, who was charged with investigating this case, had already been in the process of introducing a criminal case on fact of an assault of an unknown person on the citizen V., and rape in the same district of the city.

The evidence collected on the case allowed the investigators to set out leads of the fact that both crimes were committed by the same person.

On the basis of the findings of forensic medical examination was established that the person who committed the crimes had a blood group O.

Upon receipt of the relevant data, 618 male subjects with a specified blood group were identified. A thorough analysis of this category of citizens, taking into account the information on the identity of the alleged offender allowed narrowing the range of the specified persons to 18 people. In relation to these individuals, it was decided to select them for biological examination of blood samples, saliva and hair.

Prepared biological objects, together with the investigator's order were sent to the SSRFC of the Ministry of Internal Affairs of Ukraine for biomedical examination in order to establish the DNA profiles of the traces and their subsequent identification.

According to the findings of forensic medical examination, the presence of sperm traces revealed on the clothing of the victims N. and V., belonged to the suspected S., when the probability of accidental coincidence of genetic features is at least 1 per 10 billion people.

Taking into account the findings of forensic medical examination and other evidence in the case, the citizen S., born in 1967, was previously sentenced three times, including for rape, was arrested. During interrogation, he confessed to committing these crimes.

The findings of the biomedical examination on the establishment of DNA profiles in this case played a decisive role in exposing the particularly dangerous offender.

When solving and investigating crimes against life and health of individuals, molecular genetic examination undoubtedly affects the results of the work of law enforcement agencies. Some results of genetic research allow obtaining rather individual diagnostic characteristics of the person who committed the crime and to conduct an individual identification of a crime, etc.

Today, the offender is in keeping up with the times, uses all the advances in scientific progress, and it is often impossible to prove his guilt without genetic fingerprinting. The man at the crime scene leaves the traces and today attention is paid to leave as few traces as possible. But there are traces that persons can not but leave ranging from their secrets to smelly traces. Therefore, this concept is very in demand.

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### **Значення молекулярно-генетичної експертизи під час розслідування злочинів**

Розкрито сутність і зміст молекулярно-генетичної експертизи. Аргументовано її значущість під час розслідування злочинів. Наведено приклади проведення молекулярно-генетичної експертизи в Україні та світі.

**Ключові слова:** молекулярно-генетична експертиза, метод ідентифікації, аналіз ДНК, об'єкти біологічного походження.