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DNA Method in the Medico-Legal Expertise and Forensic Science

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ABSTRACT: In the criminal investigation, expertise has an important role in terms of finding out the truth about the criminal case. To identify or exclude suspects, specialists in the field use the DNA method, a method that is performed in forensic laboratories or in forensic institutions. The genetic fingerprint includes that chemical structure that differentiates us from other individuals and that helps specialists determine the genetic code through biological traces present on the spot. It can be seen that the DNA profile has a great utility, especially in the expertise of filiation, the establishment of biological traces, the identification of victims, the confirmation or refutation of guilt. The paper presents the importance of the DNA method and the contribution of this profile in terms of both the acquittal of the suspects and the reparation of some judicial errors.

KEYWORDS: DNA, genetic identification, forensic expertise, chemical structure, genetic code

Introduction

The discovery of deoxyribonucleic acid (DNA) led to an understanding of the concept of heredity and, subsequently, to identification, by decoding the genetic information that the DNA molecule has in its component. It has a molecular structure and is contained in all living cells of organisms.

The first presentation of the structure of DNA was made in 1950 by James Watson and Francis Crick. The DNA molecule is very large, being composed of four types of nucleotides - adenine, cytosine, guanine and thymine.

Until 1985, the study of DNA molecules was not a major concern for forensics. Alec Jeffreys and his colleagues at the University of Leicester were the first to show the infinite valences that DNA has in identifying a person by studying the biological traces of any kind left by those people at the crime scene.

The process of identifying a person begins when he leaves a biological trace containing genetic material (DNA) at the scene of the crime. Next is the taking of the sample by the forensic scientist, followed by the laboratory analysis which has as a terminus the translation of the genetic material into a code, with a unique, unrepeatable formula, specific to a single carrier of that genetic information (Stancu 2015, 167).

Genetic identification

Genetic identification consists in determining the genetic code of each individual, a relatively recent discovery, which foreshadows a real revolution in the field of forensic identification: genetic fingerprinting (Buzatu 2013, 66).

The chemical structure is different for each person, so each individual has his own biological scheme, the key to our individuality. No two genetic codes are identical, except for those coming from real twins, univitelline twins (results from a single fertilized egg divided in two) (Ionescu 2007, 81).

Only a small part of the genome has informational content (known) and encodes hereditary characters, areas of informational DNA alternating with non-informational areas. Informational DNA segments encoding a specific protein have "attached" non-informational

segments (DNA mini-satellites). In these non-informational segments multiple individual variations can be detected (segment called polymorphism), the variability being more accentuated in certain genomic areas, areas that are called polymorphic areas (Manu 2008, 419).

In terms of identification value, geneticists classify biological traces into three categories:

1. High precision tests in identifying the DNA profile: blood, semen; saliva (regardless of the types of objects it is collected on: smoked cigarettes, toothbrushes, masks, crockery, stamps, postal envelopes, etc.).

2. Samples with potential in defining the DNA profile: vaginal fluid, nasal secretions, hair (only torn hair has value for nuclear DNA analysis); pieces of meat, skin cells, urine, body parts, bones (bone marrow can be analyzed even in cases of advanced decomposition).

3. Samples with potential in mitochondrial DNA analysis. Any samples that are not suitable for other analyzes can be analyzed by mitochondrial DNA analysis (Stancu 2015, 168).

Performing the classic DNA test:

- Is harvested from the crime scene, from the victim, etc. incriminated samples of blood, semen, hair; as well as the comparative evidence from the suspects;
- Long spirals of DNA are extracted from the cells of each sample which are fragmented by cutting with the restriction enzyme and then separated by electrophoresis;
- DNA fragments are transposed on a membrane and then included in a special gel. By processing in the gel layer, DNA models (bar code) are formed which are transferred by irradiation on a film;
- The DNA models obtained appear juxtaposed on a single support. By comparing the incriminated model with those of the suspects, the similarities (identity) and the differences (non-identity) are determined (Buzatu 2013, 67).

The legal framework of performing medical examinations (genetic)

Expertise is the means of proof used in criminal trial when the complexity of the aspects of the case requires the presence of specialists.

The Criminal Procedure Code is the main legislative framework that regulates the performance of expertise and all other aspects related to the procedure of their performance, the persons and institutions involved the framework and conditions for their conduct.

An expert is a person who has specialized knowledge in a certain field of science, technology or art, officially qualified as an expert, called for clarification in the criminal process of issues involving such circumstances (Ifrim, 2014, Academia.edu).

Forensic expertise is a means of proof, a valuable probative procedure, through which, based on research based on scientific data and methods (Ciobanu and Stancu 2017, 42), "the expert brings to the attention of the judiciary scientifically motivated conclusions about facts for whose clarification specialized knowledge is needed" (Mihuleac 1971, 20).

In the system of the Ministry of Justice, the first expertise is performed at the inter-county laboratories (Bucharest, Cluj, Iasi and Timisoara) and a new expertise at the National Institute of Forensic Expertise (Buzatu 2013, 26).

Among the attributions of the Genetics Laboratory we mention the following:

1. Organizes and ensures the proper conduct of specific activities on: sampling and conservation of biological samples and criminal bodies for DNA analysis; detection and quantification of human DNA in biological samples or criminal bodies; expertise by DNA examination to establish biological filiation, paternity/maternity, based on the deoxyribonucleic acid test; expertise by DNA examination to establish the complex

relationships of biological kinship, between relatives, of degree I, II or III, expertise by DNA examination in order to identify persons.

2. elaborates the medico-legal documents related to the activity;

3. ensures the identification and traceability of the distributed medico-legal works;

4. ensures the communication with the competent institutions, as well as with the interested natural persons, in the specific field of activity, with the observance of the confidentiality of the medico-legal act;

5. ensures the preservation of the chain of custody of the sample (collection, processing, preservation, restitution, destruction);

6. ensures the periodic evaluation of the laboratory performances by participating in the inter-laboratory tests on domestic and international level (INML 2020, inml-mm.ro).

The new expertise is ordered either ex officio or at the request of an interested party, when the verification of the first expertise is pursued by another expert or by a commission of experts. Thus according to article 125 of the Criminal Procedure Code, if the criminal investigation body or the court has doubts regarding the accuracy of the conclusions of the expertise report, it orders the performance of a new expertise (Buzatu 2013, 26).

The special medico-legal commission that performs the new expertise carries out its activity only within the National Institute of Forensic Medicine "Mina Minovici" Bucharest, being a unique commission in the country. It should be noted that the new expertise report represents another level of functional competence and, consequently, the conclusions formulated remove other opposing views expressed in a report of the expertise (Iftenie and Dermengiu 2014, 546-547). DNA expertise is regulated by article 190 of the Criminal Procedure Code. It can be ordered when it is necessary to establish the identity of a person or if the traces found come from the suspect, defendant or injured person.

The object of the expertise is the samples taken during the physical examination and any other evidence that was found or collected. DNA expertise is performed within medico-legal institutions, a forensic expertise laboratory or any other specialized institution certified and accredited in this type of analysis. The biological material is made available to the expert without the identification data of the person from whom they were taken and the results obtained are considered personal data and are protected according to law.

The provisions of the Criminal Procedure Code regarding judicial genetic expertise are similar to those regarding DNA expertise. It can be disposed of in the same manner and by the same persons, and the resulting genotyping is personal and is protected by law. In addition, the biological samples collected during the examination can be used only to identify the judicial genetic profile and can be used in other cases if necessary, in order to find out the truth ((https://www.academia.edu).

The usefulness of the DNA profile in forensic and judicial practice

The DNA profile plays an important role in:

- Affiliation expertise;
- Establishing biological traces (blood stains, vaginal discharge, semen, hair bulb, tissue fragments);
- Identification of the species to differentiate human/animal origin;
- Identification of blood samples taken for alcoholism;
- Identification of cadaveric/skeletal remains;
- Identification of victims;
- Confirmation/denial of guilt in sexual crimes and homicides.
- Reopening unresolved cases or checking erroneous convictions. Because DNA maintains its integrity in dry specimens for a long time, it can reopen old cases that are disposed of in the preservation of biological samples.

In a study conducted between June 1995 and June 1996, the US Department of Justice examined the cases of 26 people tried and convicted of sex crimes/sex crimes-crime, who were acquitted following a retroactive investigation of the DNA profile. These people, unjustly convicted, served between 9 months and 11 years of punishment (7 years on average). The conviction was based on visual identification by the victim/witnesses and demonstration of similarity by non-DNA methods between the suspect and the biological traces found on the face place or on the victim's body.

- Creating an international bank of criminal fingerprints of criminals. England is the first country in the world to set up a national DNA database in 1995 (Manu 2008, 425-426).

Scientific progress requires thorough and long-term research into as many genetic data as possible. There are thus undeniable benefits of genetic data processing.

Increasing the quality, size and diversity of genetic databases allows for more accurate diagnosis, targeted therapies, more effective prophylaxis measures, and the identification of potential risks of developing hereditary diseases, which are just a few of these benefits.

The analysis of information stored in DNA can have other uses: diagnosis and targeted treatment of certain diseases from the intra-uterine stage, establishing paternity, determining the degree of kinship, identifying ascendants or extinct relatives, tracking the evolution of species of organisms, identifying people in for the purpose of performing the act of justice or for the purpose of gathering information relevant to the national security of a state.

In view of the evolution of artificial intelligence, DNA microarray technology is a widely used and well-founded method in bioinformatics. Easy access to real data sets and the corresponding results, obtained by various methods by many researchers, offers a major opportunity to develop artificial intelligence methods in a consolidated and widely explored framework. The ability to evaluate the performance of new methods of evolutionary algorithms in the analysis of real data, the chance to compare the behavior of proposed methods with repeatedly tested approaches, and the potential to improve DNA microarray data analysis methods is extremely attractive (Oprea and Alecu 2020, hotnews.ro).

Thousands of unresolved cases could be reopened and resolved thanks to an innovation in DNA analysis.

Scientists have already proclaimed the new method as the most important progress in this field in the last decade. The method was tested in a pilot program and proved to be a success, and police and forensic investigators have already begun searching the archives for old, unresolved cases that could be solved with the new method.

The technique, developed by the Forensic Science Service (FSS) in the United Kingdom (the forensic service under the government) and called DNA Boost, makes it possible to create genetic profiles even in the case of "mixed" samples, namely when samples carrying genetic information taken by they come from two or more people at the crime scene. Approximately 10% of DNA samples analyzed in the UK by forensic scientists have this feature, and until now it was practically to researchers.

The method developed by FSS involved the creation of software that analyzes the mixture and "pairs" the information, signaling the possible correspondences. Such reconstituted DNA can be searched in the DNA database (which currently contains about 1 million records), and thus possible suspects can be designated (Descopera.ro 2009).

The value of the DNA method

Recent advances in the field of DNA profiling have transformed this type of investigation into an investigative tool of great importance for Forensic Medicine due to its indisputable qualities:

- The method has specificity and a capacity of discrimination clearly superior to the classical methods of serological identification;

- Allows the identification of biological traces even when they are found in infinitesimal quantities;

- Can be successfully applied even when the biological traces are very old and degraded.

In the administration of justice, the contribution of the DNA profile is the exoneration of guilt of the suspects and the avoidance or reparation of committing judicial errors.

The evolutionary needs that determine the future directions of DNA technology are:

1. The creation of an International DNA Data Bank for medico-legal use, connected with similar databases, is necessary due to the ever-increasing flow of information and the need for real-time access to this data.

2. Internationally coordinated research programs. Research should be conducted according to an international program, focusing on priorities.

3. Improving DNA technique. The rapid evolution in DNA technology recorded in the last decade should continue towards improving the techniques of extraction, detection and filtration of contaminated DNA, increasing the reliability of DNA techniques (automation, computer interpretation)

4. Standardization of laboratory techniques. Due to the current diversity of laboratory procedures and techniques, an international effort is needed to standardize laboratory procedures (Manu 2008, 432-433).

Conclusions

Expertise tends to occupy an important place in criminal investigation, and knowledge and specialization help the possibility of improving the activity of justice. It can be seen that the most requested expertise are those in the field of forensics and forensic medicine. Forensics and forensic doctors perform complex expertise there is a close collaboration between them, in this way, following a bill that refers to an autonomous regulation for such categories of expertise.

Lately, new technologies, which deal with the use of DNA to find the real culprits, are constantly evolving, this being due to the use in a wide range of information that comes to the aid of professionals in the forensics.

Genetic analysis has provided and continues to provide positive results in terms of finding out the truth, by identifying the offender, but also to ascertain the innocence of people who could be suspected of their involvement in a criminal case.

When a crime is discovered, at the crime scene, biological traces can be found, from which the genetic profile is determined. It is obtained from the use of new modern software tools in forensic genetics laboratories. Thus, specialists will find out certain characteristics of the individual, such as: eye color, hair color, age, which means defining the forensic path.

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