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Functioning of DNA Database in Poland

Summary

Forensic DNA databases that operate in the zone forming an interface between science and law have the purpose of gathering and processing DNA profiles for the needs of law enforcement and judicial authorities responsible for preventing and combating crime. Therefore, their appropriate functioning is important. On one hand, it improves efficiency of police work and, on the other hand, it has to play a required role in protecting citizen rights and personal data. The National DNA Database has functioned in Poland since 2007. Its effectiveness is correlated with the number of stored profiles. Despite small collection the Database has on numerous occasions proven its high usefulness in solving criminal cases. The possibility of carrying out searches in other countries databases, as well as legislative and organisational undertakings aiming at improvement of the Database operation are gradually bringing effects and result in an increased detective potential of this tool.

Key words: DNA database, functioning of the national DNA database, DNA profile, comparing DNA profiles, network of links between crimes, international Exchange of DNA data, measure

Introduction

Due to developments in science and technology, in recent years, the use of DNA databases has been probably the most influential factor in the area of criminal justice (Butler, 2009). Nowadays, the Databases are concerned integral Police tools that are growing in importance (Bromley, 2009) but are also used by other services responsible for national safety (in Poland e.g. Agency of Internal Safety or Border Guards). Their potential comes not only from the possibility of identifying a perpetrator basing on a trace left at a scene of crime, but also the potential of linking crimes and creating a network of links between incidents.

The first DNA Database aiming at identification of offenders in Europe was created in 1995, in Great Britain (Schneider, 1998). In subsequent years, databases in the Netherlands, Austria and Germany followed. According to the European Union legislation all the Member States are obliged to create national DNA databases to be used for crime detection (article 2 point 2 of Council Decision 2008/615/JHA of 23 June 2008). Depending on national regulations collections of DNA profiles in various countries have different organisational structures (Schneider, 2001) and various categories of profiles may be processed. DNA profiles are stored and compared in a number of differing IT systems. The most popular one is CODIS software (Combined DNA Index System), which was created in the United States of America for the needs of the Federal Bureau of Investigation (FBI). The software is used by approx 50 DNA databases throughout the world, including Polish national Database.

Polish National DNA Database

Polish DNA Database was registered on 23rd April, 2007 in the non-classified register of personal data collections maintained by the General Inspector of Personal Data Protection. Its Administrator, in the understanding of the Act of 29th August, 1997 on personal data protection is the Chief Commander of the Polish Police. In the Database, only information about the non-coding regions of DNA is maintained

(article 20 of the Police Act of 6th April, 1990). According to the provisions of the Police Act, the data processed in the database concern persons defined in art. 74 and art. 192a of the Criminal Proceedings Code, unidentified persons and persons attempting to conceal their identity, unknown corpses, traces of unknown crime perpetrators (unknown traces), persons posing a threat referred to the Act of 22 November, 2013 on activities towards persons with mental disorders posing a threat to life, well-being or sexual freedom of other persons, missing persons, persons mentioned in article 15 point 1 (3a – c) of the Police Act, juveniles committing offences prosecuted by indictment, as well as persons referred to in article 10 of the Act of 10th June, 2016 on Antiterrorist Activities. DNA profiles, on case-to-case basis, are entered to the DNA Database basing on an ordinance of the authority leading preparatory proceedings, court or locally appropriate Police unit. In case of persons referred to in article 10 of the said Act, DNA profiles are submitted to the Chief Commander of the Police for the purpose of registration in the Database by an ordinance of the responsible organ, e.g. Agency of Internal Safety or Border Guards (§9 point 3 of the Council of Ministers Ordinance of 25 July, 2016).

DNA profiles of persons mentioned in article 74 of the Criminal Proceedings Code obtained for the needs of the National DNA Database are elaborated exclusively by the Central Forensic Laboratory of the Police (CFLP), while unknown stains recovered at crime scenes can be profiled by CFLP, Voivodeship Commands Forensic Laboratories, Metropolitan Police Forensic Laboratory, as well as non-police centres, institutions or scientific units dealing with research and issuing opinions in the area of forensic DNA examinations for the needs of carried out proceedings. At present, in the National DNA Database there are approx. 70 000 DNA profiles, 83% of which come from persons mentioned in article 74 of the Criminal Proceedings Code, while approx. 12% constitute unknown crime scene stains profile. The remaining 5% are profiles of unidentified corpses, missing persons and their relatives.

For DNA profiling of biological samples each country uses a certain set of genetic markers, called STRs (short tandem repeats) (Butler, 2006). As stipulated in the Council Resolutions 2001/C187/01 and 2009/C 296/01, the minimum set of markers required for international exchange of profiles is known as a determined European Standard Set of markers. Its core is made of TH01, vWA, FGA, D21S11, D3S1358, D8S1179 and D18S51(ENFSI, 2016). This panel was extended by five additional STRs: D1S1656, D2S441, D10S1248, D12S392 and D22S1045. In case of DNA analysis there is an explicit tendency to continuous increasing of analysed

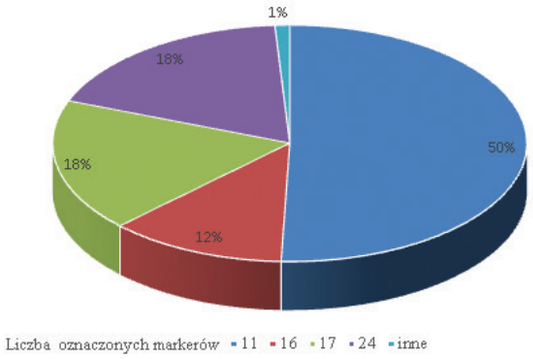

Fig. 1. Percentages of reference samples profiles with various numbers of markers from persons mentioned in article 74 of Criminal Proceedings.

polymorphic markers (Achrem, 2015) and thanks to that the probability of repeated set of alleles in a population is particularly rare. The minimal criterion for entering a DNA profile to the Polish Database is now eight full STRs and sex gene (amelogenin). In case of reference profiles, whose donors are mainly persons mentioned in article 74 of the Criminal Proceedings Code, approx. 50% of them are profiles with ten full STRs and sex marker (comp. Fig. 1). At present, in the routine work of the National DNA Database, 24 loci including the sex marker are analysed in material from referential samples. The division of unidentified stain profiles depending on the number of labelled markers is presented in figure 2.

Also partial DNA profiles, i.e. profiles, for which it was not possible to obtain a full set of STR markers may be registered in the DNA Database. In some cases also profiles non-compliant with the criterion of required minimum set of loci. This concerns cases of serious crimes or older cases, in which due to various reasons there is no possibility of profiling in a broader range. However, it is necessary to take into consideration that as a result of searching the database a lot of, so called, false positive matches,

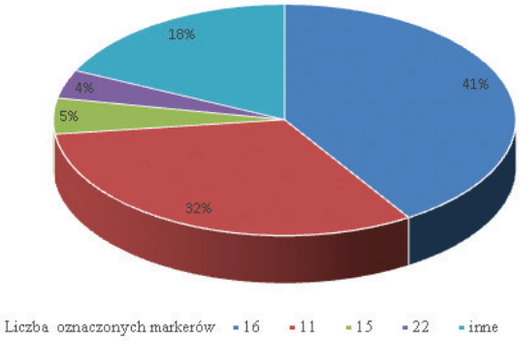

Fig. 2. Percentages of unknown traces profiles with various numbers of markers.

will be obtained, which does not exclude actual indication of a potential perpetrator.

Also markers determined on chromosome Y are entered into the database. They are specific for male sex and therefore have become a valuable tool in numerous criminal cases, particularly rapes (Edlund, 2010) and in cases requiring confirmation of relations, e.g. between unknown corpses and family members of missing persons. It should be kept in mind, though that due to the model of inheritance the discrimination power of Y-STR markers is much lower than in case of autosomal STRs, therefore it is necessary to estimate the frequency of occurrence of a given haplotype in the population.

The time of maintaining the results of deoxyribonucleic acid and biological samples in Polish DNA Database depends on the perpetrated crime and as a rule equals 20 years or 35 year in case of high profile crimes. According to article 21d of the Police Act within the DNA Database there is also a collection of biological samples, such as buccal swabs, blood, hair roots or secretions and tissue samples in case of dead bodies, recovered from persons or unknown corpses with the purpose of carrying out deoxyribonucleic acid analysis. Thanks to that it is possible to repeat the profiling with an extended set of markers, which become available with progress in this area, creation of new reagents and improvement of method sensitivity. It also ensures a possibility of verifying the previous results.

Records stored in the DNA Database are removed in case of lack of grounds for their further processing or using by the Police. Depending on circumstances records are immediately deleted, e.g. in case of final and valid acquittal of an individual or concluding a case of a missing person, and in case of remitting the criminal proceedings, the record is removed after expiration of crime penality limitation period.

Comparison of DNA profiles

The main purpose of DNA Databases is comparing entered DNA profiles with the entire collection. Searches are performed on day-to-day basis upon entering every new profile. Also single comparison between profiles are possible. Depending on the category of DNA profile there are three main types of database searches in CODIS system:

1. Search with use of "searcher" module allowing comparison of DNA profile by means of the following strategies:
   – High stringency search – all the alleles found in every compared locus of the searched profile have to be present in the candidate profile. It is, so called 1:1 comparison.
   – Moderate stringency search – assumes a match in a situation when in the compared profile in a given locus there is a heterozygote, while in the candidate profile there is a homozygote, e.g. when in the locus of the compared profile there are allele values 12, 13, in the candidate profile value 12 or 13 may be found. This type of search may be used in a comparison of mixtures. Due to the fact that in CODIS homozygotes are labeled with one value of allele, a search in this strategy may contribute to detection of allelic drop-out in one of the DNA profiles.
   – Low stringency search – assumes that in every compared locus at least one allele must be present in a typical profile. This type of search is used for parent – offspring linking.
2. Involving use of "pedigree-manager" module enabling generation of genealogic trees out of profiles of persons related to the missing persons and searching these trees in the Database.
3. Familial searching – involves searching for a profile similar to the profile of a trace recovered at a crime scene, but not demonstrating full match. The aim of that search is to create a list of profiles from persons related to the perpetrator. This type of search us widely used in Great Britain and the U.S.A.

In a lot of cases, as a result of searching the DNA database a so-called near match is obtained. This occurs when in two compared profiles there is a difference in values in just one allele in one locus. The causes for obtaining a near match may vary. They may result from human error during manual entering of either of the profiles or occur in the laboratory phase, e.g. when an allelic drop-out, drop-in or null allele occurs in one of the labeled loci. The difference may result from using different sets of reagents. It is caused by a natural phenomenon of mutation in primer binding sites. Independent of the reason, such an inconsistency should be verified.

In case of obtaining a match/hit between profiles, it should be officially approved. Some countries, in case of stain/person match apply the requirement of repeated collection of a sample from the suspect in order to verify accuracy of profile labelling. In other countries, however, a new sample collected from the suspect is analysed (ENFSI, 2016). The latter procedure is used in Poland.

In case of a match between a partial profile and/or dominating (major) profile from a mixture (this refers to unidentified stain) the National Database asks for verification and approval of correctness of alleles labelling by a forensic expert.

After confirmation all the information on the match between DNA profiles are submitted to the

officers conducting criminal proceedings, preparative proceedings in juvenile cases or carrying out detective or identification activities (article 21d of the Police Act).

One should keep in mind that in Poland a hit in the Database constitutes only an intelligence indication and may not be admitted as evidence in court. In order to be able to use a match from the Database in pre-court proceedings it is required to collect reference material from the suspect with observance of all the required proceedings and then appoint an expert who will elaborate a forensic opinion.

Uses of DNA Databases

The development of analytical technologies allows for more and more effective use of DNA databases as detective tools. Potential to obtain matches is correlated with the number of recorded profiles therefore it is important that profiles are continuously and steadily added to the Database, i.e. not only unidentified stains profiles but also referential profiles should be entered.

Every match of profiles brings certain information. The most desirable outcome of a search is a stain-suspect hit leading to identification of the perpetrator of a crime, or unidentified corpse / unidentified person to person, unidentified corpse/ unidentified person to relatives of a missing persons, leading to an identification. Nevertheless, also matches of the type stain to stain or person-person are highly useful for the investigators. In case of stain to stain match it ought to be kept in mind that the Database comprises profiles of traces recovered from two or more crime scenes and the perpetrator has probably not been detained or tried in court for any of those crimes. Therefore this type of match gives a possibility of detecting a serial criminal. Moreover, it allows to understand the psychological profile of the perpetrator, his/her modus operandi, are, in which he/she was active and whether the criminal is developing his/her techniques, or not (Lammers, Bernasco, Elfers, 2012). Thanks to crime analysis also the police can change the initially adopted strategy and thus contribute to sooner arrest of the perpetrator.

Person to person match not only makes it possible to confirm the identity but also to connect committed crimes with a perpetrator attempting to conceal his/her identity.

In last two years in the National DNA Database 60% of hits has constituted stain to person matches. These are, so called, “cold hits”, i.e. hits where the suspect was unknown or both profiles were recorded in the Database.

Hits obtained in the Database can be also used for crime linking (Jeuniaux, Duboccage, Renard, Renterghem, Vanvooren, 2016). An example of a network related to burglary and theft is presented in fig. 3. Individual Police Units entered profiles of unknown crime scene traces A, B, C, D, E, F and G into the Database. Traces marked with the same colour were recovered to one case but their profiles did not match, which could have indicated that more than one perpetrator had taken part in the incident. Initially, a hit of A and B profiles was found, which would have indicated the same perpetrator. The Area Police Command (KPP) in Jasło registered also profile

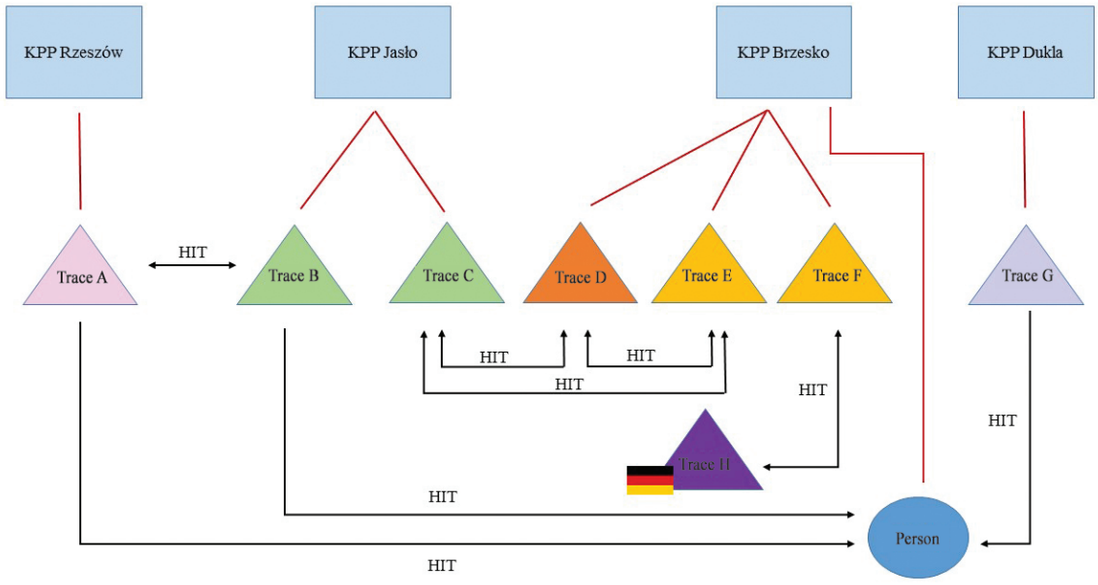

Fig. 3. Network of links between crimes created basing on matches in DNA Database.

C in the case and also in that case a hit was obtained with traces D and E registered by KPP in Brzesko. The above Unit registered also a suspect whose profile matched traces A, B and G (investigation conducted by KPP in Dukla) and that made identification of the perpetrator possible. Basing on the results reached at this stage it can be concluded that the offenders had been active in the South of Poland. The exchange of data between databases of the EU states provides even better possibilities of matching profiles. An example of that is a hit between crime stain profile F (registered by KPP in Brzesko) and crime stain profile H in German DNA database.

Results of comparing DNA profiles in the Database enable obtaining a lot of new information, including links between crimes that at the first sight have no connection with one another.

International exchange of DNA data

Quick and efficient exchange of accurate information is crucial for effective cooperation of EU Member States law enforcement authorities in counteracting international crime. One of the tools facilitating this task is automated exchange of DNA data performed under the provisions of Council Decision 2008/615/JHA of 23 June 2008, so-called Prüm Convention. Through providing reciprocal online access to national DNA databases the Member States can execute rapid checks of unidentified profiles in DNA databanks of other EU Member States. In the CFLP Biology Department the National Contact Point for DNA information exchange with EU States has been operating since January, 2013 when it was set up under art. 145j of the Police Act. The main responsibilities of the Contact Point include ensuring the possibility of 24/7 searches of DNA profiles against Polish DNA Database, making searches in DNA databases made accessible by other countries and verification of international hits. At present, DNA information exchange is carried out with the Netherlands, Austria, Germany, Spain, Lithuania, Romania, France, Czech Republic, Slovakia, Slovenia, Cyprus, Finland, Hungary, Latvia, Estonia, Sweden, Malta and Portugal. Accessible collections from all those countries total to over 5 million reference DNA profiles. So far, as the result of international searches 3 150 hits have been obtained including 939 PL person to EU casework stain hits, 303 PL casework stain – EU person hits and 378 PL casework stain to EU casework stain. Also advanced works are in progress on setting up connections with DNA Databases of other EU countries. It has to be emphasised that the data being subject to automated exchange include exclusively so-called anonymous DNA profiles without any additional information, which would enable direct identification of a person in question. In case of obtaining an international hit the countries concerned may address each other and ask for further personal data of other information about the investigation (so-called, "Step 2"). In Poland this task is executed by the National Contact Point in the Department of Coordination of International Information Exchange of the Police International Cooperation Bureau in the General Police Headquarters. Until now, as the result of obtained hits, approx. 846 cases related to post-hit transfer of information have been further proceeded.

Evaluation of Polish DNA Database operation and development

The Catalogue of Priorities and Priority Tasks for year 2016-2018 adopted by Chief Commander of the National Polish Police for years 2016-2018 comprises, among others the following task closely related to improving the functioning of the National DNA Database: "Increasing the capacity of using DNA and AFIS Databases through creating DNA Database access workstations in forensic DNA departments of Voivodeship Forensic Laboratories and Metropolitan Forensic Laboratory, improving legal regulations concerning entering data to DNA and AFIS Databases, as well as raising the awareness of police officers in the area of using information both from national and foreign DNA and fingerprint databases." Putting forward this particular task for Chief Commander's approval had been actually an outcome of a qualitative survey concerning the opinion of forensic experts on strong and weak points of the Polish Police in the context of functioning of the DNA Database. The survey was filled in by 279 experts from investigative police units at voivodeship level. The strong points that respondents mentioned included, among others: "(1) the very fact of DNA Database existence, (2) wide range of data stored in the Database, (3) the possibility of making various searches (including international ones), (4) unambiguity of obtained hits and their high usefulness for identification, evidential and detective purposes, (5) the possibility of crime linking through crime scene stain – crime scene stain hits", as well as "(6) good cooperation with the Central Forensic Laboratory of the Police". The most frequently identified weak points of the Database were "(1) low quantity of data collected in the database", which directly corresponds with poor detective potential. This is related to other flaws, such as: "(2) over-formalised and time-consuming registration procedures, (3) too small knowledge of the servicemen on the operation of the DNA Database" (approx. 20% of them are not aware of its existence), "(4) lack of access to the Database at voivodeship level, "(5) incompatibility to

KSIP (National System of Police Information), (6) few trainings on the DNA Database". According to article 20 point 2c of the Police Act the required prerequisite for recording a profile in the Database is the evidential, identification or detective value of this information. This rule is interpreter in various ways, which leads to the situation where police officers often refrain from entering a profile in the Database. Therefore, there is a need to introduce to the Police Act clear provisions determining the catalogue of offences whose suspicion will entail a requirement of entering a DNA profile in the database. Unfortunately, so far the attempts to implement such a provision to the Police Act have failed. Other drawbacks of the Database include: "(7) lack of regulations enabling maintaining an elimination DNA Database". The statistics provided by countries maintaining elimination databases presented during ENFSI DNA Working Group demonstrate that approx. 10-15% of unsolved crime scene stains profiles actually derive from biological material left by staff involved in recovery of evidence at crime scenes or performing DNA analysis. "(8) no possibility of registering in the Database DNA profiles of persons identified in forensic DNA expert opinions." Such a possibility has been incorporated in draft Ordinance that is to replace, at the beginning of 2017, the present Ordinance of 29.12.2005 by the Chief Commander of the Police no. 1565. "(9) lack of legal possibility to use Database information in the pre-court and court proceedings." In this aspect not much can be improved. The Database is a non-judicial tool. A hit in the Database has to be confirmed by a DNA expert opinion. The status of implementation of the task adopted for years 2016-2018 is measured by the ratio of number of individual DNA profiles from unknown crime scene stains obtained from expert opinions and sent to be entered into the Database in a given year to the number of individual unidentified crime scene stains from expert opinions performed by voivodeship and Metropolitan laboratories fulfilling the criteria of entering in the DNA Database, i.e. containing a minimum number of eight complete STR loci and amelogenin. The minimum index that has been adopted equals 70%. Introducing this measure resulted in 2016 an increase of the number of unknown crime scene stains profiles by 42%, as compared with year 2015.

In the Survey the respondents signaled the need for creating access points to the DNA Database in Voivodeship Forensic Laboratories. This will be possible from 2018. Presently, the IT and Communication Bureau is working jointly with CFLP to making operational a new CODIS server dedicated to serving remote laboratories. After its launching and purchase of DNA access stations remote laboratories will be able to connect to the system. Access to CODIS will enable performing searched and contributing profiles to the Database.

Summary

The National DNA Database is an effective tool supporting law enforcement authorities on the crusade against crime and in cases of missing individuals and identification of unknown persons. So far, in spite of its small collection the Database has on numerous occasions proven its high usefulness in solving criminal cases. The possibility of effecting searches in other countries databases, as well as legislative and organisational undertakings aiming at improvement of the Database operation are gradually bringing effects and result in an increased detective potential of this tool.

Sources of figures:

Figures 1–3: author

Bibliography

1. Achrem, W., Wolańska-Nowak, P., Sołtyszewski, I. (2015). Opinia biegłego z zakresu badań genetycznych, *Prokuratura i Prawo*, *10*.
2. Act of 10th June, 2016 on Antiterrorist Activities.
3. Act of 16th September, 2011 on Exchange of information with law enforcement authorities of EU Member States (Journal of Laws, 2011, No. 230, item 1371).
4. Act of 6th June, 1997 Code of Criminal Proceedings (Journal of Laws, 1997 No. 89, item 555 with amendments).
5. Bramley, B. (2009). "DNA databases". W: J. Fraser, R. Williams, (red.), *Handbook of Forensic Science*, Devon: Willan Publishing.
6. Butler, J.M. (2006). Genetics and genomics of core short tandem repeat loci used in human identity testing, *Journal of Forensic Sciences, 51* (2).
7. Butler, J.M. (2012). *Advanced topics in forensic DNA typing: methodology.* Maryland: Elsevier.
8. *Catalogue of measuring indices for voivodeship (metropolitan) Police Commands for 2016*.
9. Council Decision 2008/615/JHA of 23 June 2008 on the implementation of Decision 2008/615/JHA on the stepping up of cross-border cooperation particularly in combating terrorism and cross-border crime.
10. Edlund H. (2010). *Sensitive Identification Tools In Forensic DNA Analysis*, Uppsala: Acta Universitatis Upsaliensis.
11. ENFSI DNA Working Group: DNA database management review and recommendations, *Publication*. Downloaded from: http://enfsi.eu/documents/other-publications/, 27.09.2016 r.

12. ENFSI survey on DNA Databases in Europe – June 2016 r.
13. Jeuniaux, P., Duboccage, L., Renard, B., Renterghem, P., Vanvooren, V. (2015). Establishing networks in a forensic DNA database to gain operational and strategic intelligence, *Security Journal, 00.*
14. Lammers, M., Bernasco, W., Elffers, H. (2012). How Long Do Offenders Escape Arrest? Using DNA Traces to Analyse when Serial Offenders Are Caught, *Journal of Investigative Psychology and Offender Profiling, 9*.
15. Prime Minister's Ordinance of 25 July, 2016 on collecting and transferring images of skin ridges and biological material, as well as image of a person not being a citizen of the Republic of Poland.
16. *Report from the qualitative survey on DNA and AFIS operation performed by sending questionnaires to forensic experts* (April 2015). Department of Analyses of Police Chief Commander's Cabinet.
17. *Report from the qualitative survey on DNA and AFIS operation performed by sending questionnaires to forensic experts* (April 2015). Department of Analyses of Police Chief Commander's Cabinet.
18. Schneider, P. (1998). DNA Databases for Offender Identification in Europe – The Need for Technical, Legal and Political Harmonization. *Proceedings of the Second European Symposium on Human Identification*, Innsbruck.
19. Schneider, P., Martin, P. (2001). Criminal DNA databases: The European situation, *Forensic Science International*, *119*.
20. The Police Act of 6th April, 1990 (Journal of Laws, 1990 No. 30, item 179 with further amendments).

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