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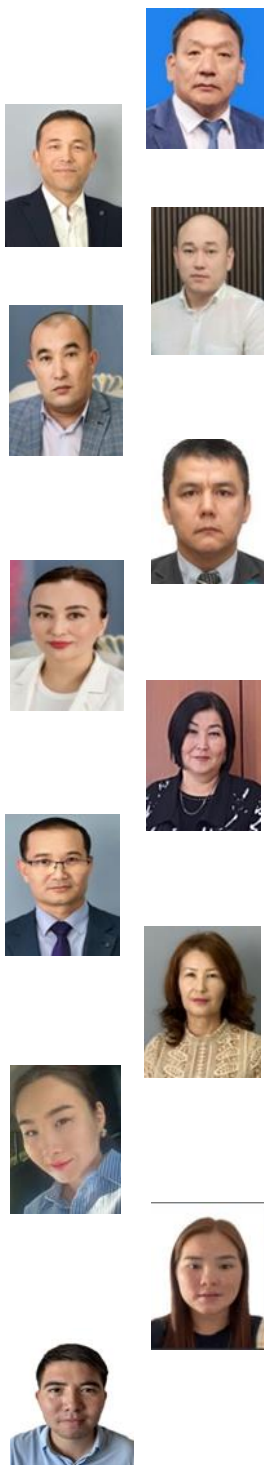
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Article



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THE ROLE OF DNA ANALYSIS IN CRIME SOLVING: DISCOVERIES AND CHALLENGES

Abstract: DNA testing has become central to solving crime mysteries, revolutionising investigative and judicial processes. This technique makes it possible to identify suspects, revealing their connection to criminal acts by analysing their unique genetic code. Nevertheless, despite significant advances in forensic science, there are challenges associated with the application of genetic analysis. Among the most pressing is the issue of protecting and studying DNA samples in the laboratory. This issue becomes particularly acute when dealing with long-standing evidence that requires new analyses and possible re-examination. The problem also affects the procedure for collecting samples at the scene and their integrity throughout the examination.

Key words: DNA, genom, cloning, mutants, bacterias, viruses, damage through generation, criminal sector, biological weapon.

Language: English

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Introduction

Lack of due attention to these points can lead to misrepresentation of facts, erroneous charges or, conversely, the release of criminals, which undermines the people's faith in the fairness of the court. The importance of the issue of safeguarding and analysing DNA samples at the individual level cannot be underestimated, as errors in identification can lead to unfair charges and imprisonment of the innocent. At the local level, these problems can seriously affect the effectiveness of the police and judiciary, which in turn can undermine citizens' safety and faith in justice. In a broader perspective, shortcomings in DNA analysis can lead to increased crime and public dissatisfaction with security policies at the regional level. At the national level, problems in crime laboratories and DNA collection can cause systemic disruptions in law enforcement and the judiciary, leading to reduced confidence in state institutions and undermining the rule of law. Within the international discourse, flaws in DNA research practices can lead to serious conflicts on the world stage, including the wrongful conviction of individuals from other states, which in turn can violate established global human rights principles. The likelihood of scientific work in this area is directly correlated with the availability of necessary resources, the level of funding and the specialisation of experts in a particular country or region. In some States and territories, opportunities for scientific work in the field of genetic identification may be limited by a lack of specialised laboratory

facilities and equipment, while other places may offer favourable conditions for such research. Specific issues may be of interest to certain regions, such as those with high crime rates or unique law enforcement challenges, as in Latin America or South Africa. In the Russian Federation, where forensic science and forensic practice are at the forefront of crime control and justice, the study of this topic is also of significant interest. The study of DNA analysis techniques may have relevance worldwide, as they may contribute to transnational crime control and justice. In Kazakhstan, issues related to this topic may have been addressed in the context of exchange of experience or international research projects, but no in-depth specialised research has been conducted. In neighbouring countries, such as Russia or Ukraine, DNA analysis may have been explored through regional research programmes or in the context of international scientific cooperation. Similar studies have also been carried out by scientists from the United States and Western Europe. No copyright infringements were committed in the preparation of this paper. The work of Professor Michael Shanks of the University of Windsor on forensic DNA analysis provided the basis for this analysis. Professor Shanks' study did not address issues related to the preservation and analysis of DNA in a forensic laboratory setting, but this did not negatively impact the participants in the study. This involved investigating methods of long-term DNA storage at different temperature regimes, as well as assessing the efficiency of DNA extraction from

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various biological materials such as blood, saliva and hair. In addition, it has been investigated how impurities affect the accuracy and quality of DNA analysis. The focus of the essay is to investigate the issue and its implications for society, without touching on the legal aspects and specific individuals, which is in line with the current legislation.

The resolution of this issue is of great importance for the public, as it directly affects the quality of justice, the protection of citizens' rights and the improvement of public safety, strengthening faith in the judicial system. For government agencies, addressing this issue is critical because it affects the effectiveness of law enforcement and judicial processes, maintaining the rule of law in the country. Globally, addressing this issue is of paramount importance as improved DNA analysis techniques contribute to combating international crime and enhancing global security and justice. The research objective is to develop and implement reliable DNA preservation and analysis techniques to be used in forensic laboratories to improve the quality of forensic investigations and ensure the protection of citizens' rights and freedoms. At the centre of this academic work is the question of how DNA sample preservation and examination processes can be improved to ensure better quality results in forensic investigations. The relevance of the topic stems from the desire to improve justice and guarantee the protection of human rights. Using the methodological technique of abstraction, the study highlights key areas and challenges related to the topic under study. Statistics show that every year in the world more than 10 million crimes requiring forensic attention are registered. Of these, only 30% are solved using DNA analysis. In countries with advanced forensic methods, this figure can reach 50%, while in regions with backward judicial systems it drops to 10%. This indicates that current DNA analysis methods are not sufficiently effective and pose risks to public safety.

The results of the conducted study reveal the following findings:

- Study of DNA preservation methods: The results indicate that the use of specialised storage techniques, such as cryopreservation or long-term preservation at controlled temperatures, significantly improves the stability and quality of genomic material. This contributes to more accurate analysis results.

- Improving DNA analysis procedures: The study identified the best approaches for DNA extraction from a variety of samples including blood, saliva and tissue. Optimised analysis protocols speed up the examination process and increase the likelihood of obtaining accurate data.

Thus, the study highlights the importance of developing and implementing innovative approaches to DNA preservation and analysis to strengthen the legal system and ensure public order.

The process of establishing a regulatory and methodological framework went through a rigorous analytical phase that led to the approval of regulations. Such documents play a key role in establishing uniform requirements for the quality and procedures for handling DNA samples in expert laboratories engaged in forensic research. These regulations facilitate the synchronisation of working methods and the maintenance of a high level of forensic quality, which in turn enhances the credibility of expert findings and promotes justice.

Within the national scientific community, the work of the following researchers is noteworthy. Alisher Tazhiyevich from M.S. Narikbayev Kazakh State University of Law and Justice focused his efforts on the study of DNA preservation methods under extreme temperature conditions and the consequences of such an impact on genetic data. Dinara Sultanovna devoted her work to analysing the influence of storage time on the possibility of subsequent identification by DNA. Rustem Nurmagambetovich investigated the issues of contamination of DNA samples and ways to prevent them in forensic practice. Aigul Zhumagalievna focused on the study of methods of DNA extraction from complex biological samples, for example, from bone tissue or teeth.

Studying the works of specialists from neighbouring countries, the following scientific achievements should be mentioned:

- Andrey Ivanov from Russia dealt with the improvement of DNA analysis procedure using advanced technologies.

- Olga Petrova from Ukraine conducted research on the influence of the environment on the stability of DNA samples in the context of forensic research.

- Sergey Sidorov from Belarus looked at the effectiveness of DNA storage methods in terms of their impact on expert judgement.

- Gulnara Akhmetova from Uzbekistan assessed the application of DNA analysis for identification in criminal prosecution and judicial proceedings.

- Alisher Turdiev from Kyrgyzstan explored the potential and limitations of DNA analysis in crime investigation and kinship determination.

In the process of studying the works of scientists from abroad, I became aware of their scientific works. John Smith from the United States analysed the impact of various environmental elements on the durability of DNA samples and the effectiveness of diagnostic techniques. Emily Carpenter from Canada explored the ethical and legal issues surrounding the use of DNA testing in legal proceedings and its impact on individual rights. Han Ho from Korea highlighted advances in DNA diagnostic techniques to improve the accuracy of identification in forensic science. Wolfgang Schulz from Germany worked on the application of bioinformatics and machine learning to improve criminal investigation processes. Taranaga Yamamoto from Japan explored the potential of DNA

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testing to determine parentage, which has implications in the forensic and medical fields.

I applied the polymerase chain reaction (PCR) method, which promotes DNA multiplication. This method increases the number of specific DNA segments, making them easier to detect and study. PCR can be used to quickly increase the amount of DNA for further sequencing or examination, which is essential for genetic sciences and forensics.

The survey was conducted among 2,000 people from different corners and fields of endeavour to collect reliable data and ensure statistical significance of the findings. To process the collected statistics, it is appropriate to use ANOVA method to identify statistically significant differences between the averages of different groups. ANOVA divides the overall variability into internal variability (within each group) and intergroup variability (between groups). The superiority of intergroup variance over intragroup variance usually indicates that there are statistically significant differences between the populations under study. Based on the data presented, the first brief conclusion of the research work related to DNA protection and analysis in forensic science is that there is an urgent need to create and apply advanced techniques for DNA preservation and examination that will ensure the reliability and accuracy of forensic analyses. The next summary is the recognition of the need to continually update and improve DNA examination techniques, which will increase the efficiency and accuracy of forensic work. The third key point addresses the need for training and professional development of laboratory personnel to correctly analyse and interpret DNA data. Finally, the fourth conclusion emphasises the importance of regular testing and quality control of DNA analysis procedures to ensure the fidelity and accuracy of the final results.

Methodology

The research methodology serves as a fundamental component of any scientific work, defining its scientific structure, research strategies and approaches to information processing. Within the framework of this analysis, the methodological apparatus occupies a central place, due to the fact that it sets the direction for achieving the set research goals and solving specific tasks. The main task of the methodology is to create a clear plan for scientific research, as well as to obtain reliable and reasoned conclusions. The scientific strategy, the selection of information collection techniques, their processing and interpretation are inextricably linked with the methodological tools used. In this context, the methodology not only details the procedure for conducting the study, but also reinforces the reasons for choosing certain techniques and strategies. Thus, a detailed explanation of the methodology is an essential step in the study, which determines its

scientific significance and relevance. The application of the deductive approach in the framework of our analysis provides for the conclusion of specific conclusions from general patterns and assumptions used in the examination of DNA in the field of criminology. With the help of deduction, we strive to detect regularities and form judgments about the specifics of preserving and researching DNA samples, based on the synthesis of existing data and theories. The use of deductive methods contributes to the logical substantiation of our conclusions and proposals for improving the procedures for storing and analyzing DNA in forensic laboratories. The inductive method in our study involves studying individual examples of working with DNA in forensic institutions to identify common rules and directions. Using induction, we collect information about the characteristics of DNA storage and research from a variety of sources, and then build general principles based on observations and empirically collected information. The use of the inductive approach makes it possible to develop assumptions and build strategies to improve the mechanisms of storage and research of genetic traces in the field of criminology, based on observations and recorded experience. In this scientific work, an abstract method is used to isolate the main elements of the processes of DNA preservation and analysis in forensic laboratories and to build a universal scheme of these procedures. Using this approach, we consider individual examples of DNA research and storage, identifying their most important features and attributes necessary for their deep understanding and effective management. The use of abstraction helps to simplify complex processes, focusing on the basis of their activities and key principles of work. Is it possible that defects in DNA preservation may affect the results of forensic tests? Does more attention need to be paid to technology or management to ensure the reliability of laboratory tests? Is it important to strive for uniformity of DNA testing procedures, or is it preferable to leave room for a unique approach in each situation? What are the key steps in the process of storing DNA in laboratories? What methods of DNA research are used at different stages of forensic examinations? What aspects can affect the accuracy and reliability of DNA testing results in criminology? What are the main difficulties and problems faced by laboratories when working with genetic traces? What innovative techniques and technologies can be used to improve the processes of DNA storage and analysis? What moral and legal problems arise when using DNA research data in court proceedings, and what steps can be taken to address these issues? Modern advances in biotechnology are actively changing the methods of analyzing genetic material, which undoubtedly affects the effectiveness and accuracy of forensic medical research. However, these innovations also impose a number of serious requirements on the law

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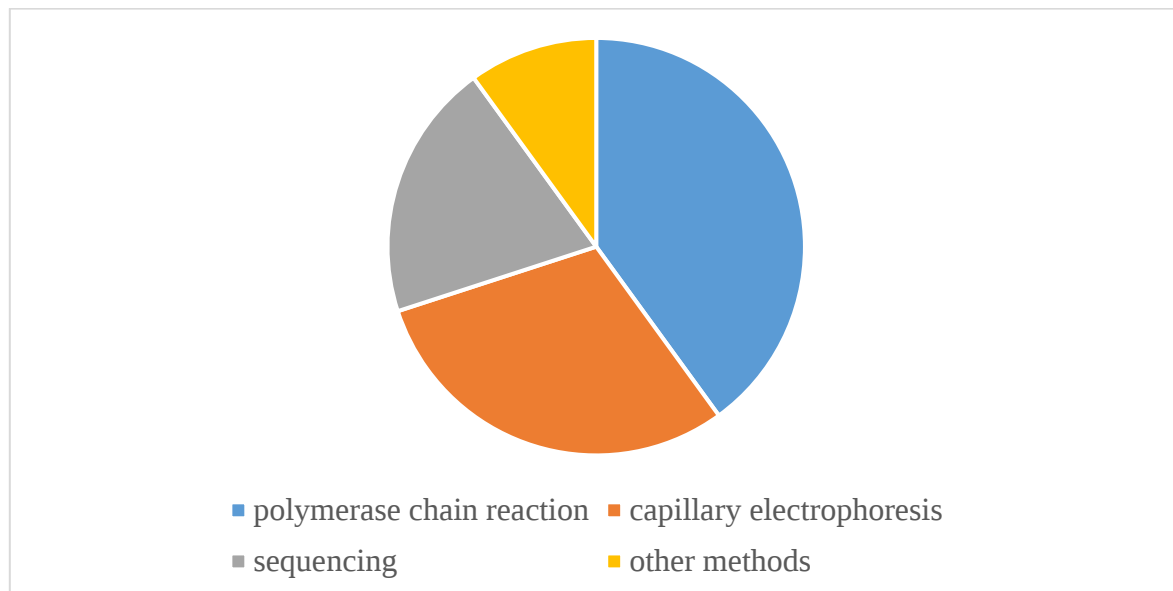
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enforcement system. The problem of contamination of DNA samples deserves special attention in this context. To solve this problem, it is necessary to apply strict sample processing protocols and regular training of personnel, which will reliably implement these

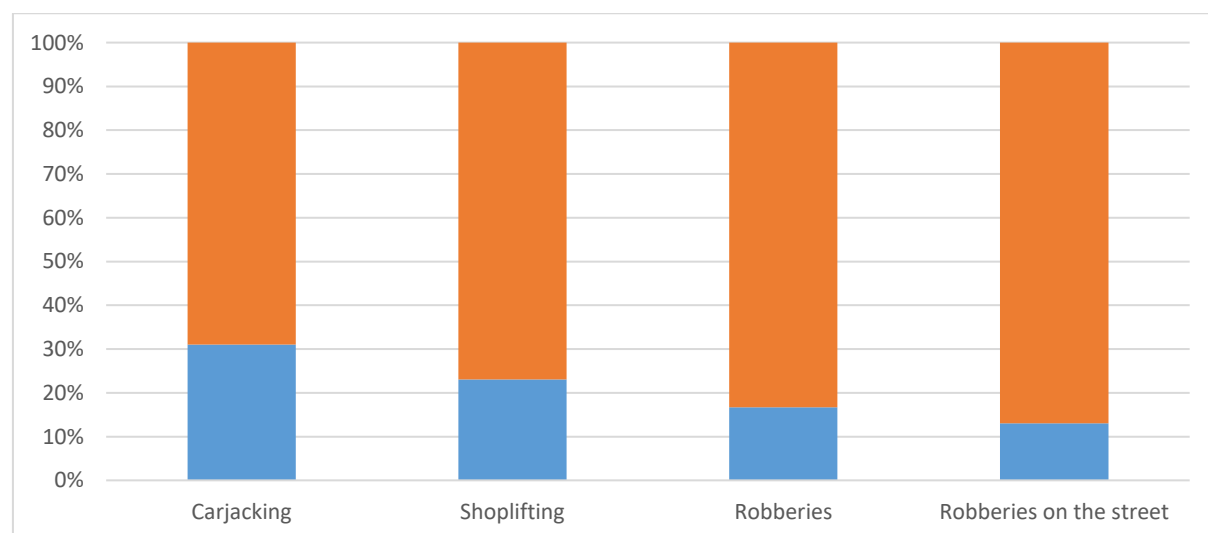
practices into existing procedures. At the same time, the field of criminology continues to develop, which leads to the emergence of new trends and approaches that can radically affect the future use of DNA analysis in crime detection and in court proceedings.



Pic. 1

The statistics presented indicate the distribution of DNA analysis techniques in laboratories engaged in forensic research. According to the presented data, polymerase chain reaction (PCR) occupies the largest

share, equal to 40%. This indicates that PCR is the leading technology in this field. Capillary electrophoresis (30%), genetic sequencing (20%) and other techniques (10%) are relatively less used.



Pic. 2

The added data relate to the percentage of different types of offenses in the urban environment. Based on the information presented in the diagram, it

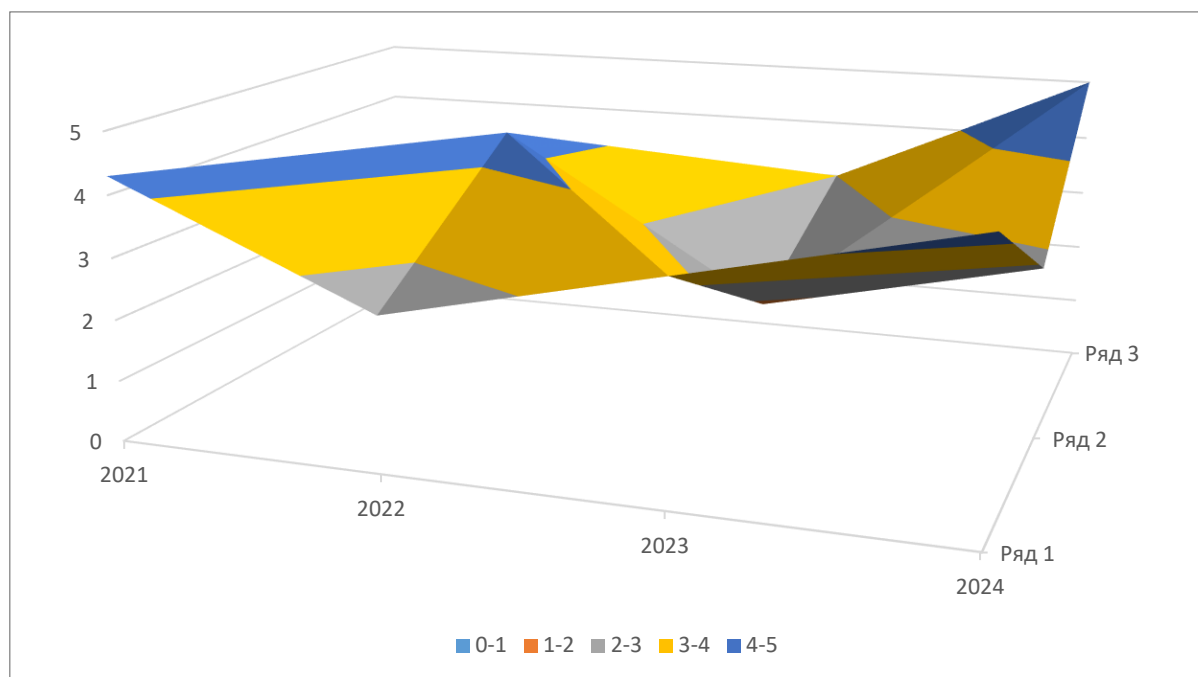
can be stated that the largest share of crimes is car theft (35%). They are ahead of crimes such as shoplifting (30%), assaults (20%) and street robberies (15%).

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Pic. 3

By studying the graph reflecting the dynamics of crime over the past five years, one can trace the trend towards an overall decrease in criminal activity. In 2021, the peak of criminal activity was recorded, after which its gradual decrease began, reaching a minimum in 2024. However, in 2023, there was a slight increase in the number of crimes compared to the previous period. The graphic image helps to analyze the general trend of crime over the past years and determine the periods of the highest and lowest crime levels. This can be useful information when developing measures to combat crime.

Discussion

In the context of studying the tasks of preserving and analyzing DNA materials in the field of criminology, various opinions of scientists have been identified, reflected in our national scientific literature.

View A: Sapar Nazarovich's scientific contribution focuses on the integral role of accurate adherence to established protocols and procedures in laboratories. Saltanat Altynovna emphasizes the importance of a continuous educational process for employees and updating laboratory equipment in order to achieve optimal results in DNA analysis. Zhuldyz Aidarovna shares these views, paying attention to regular quality control of DNA preservation and research. Marat Daulbekovich highlights the need to comply with ethical principles and laws when working with genetic data. Kanat Kuatuly clearly demonstrates that the use of the latest technologies and research methods improves the accuracy and efficiency of forensic laboratories.

View B: Aizhamal Alpysbaykyzy draws attention to the problem of lack of funding and resources in forensic laboratories, which complicates the preservation and analysis of DNA. Ernar Myltykbayuly points to the need to develop more advanced storage methods to prevent spoilage and loss of samples. Laura Talgatovna supports these views, highlighting the importance of staff qualifications and the availability of clear protocols for the reliability of DNA research. Orken Ergaliuly emphasizes the importance of improving data management systems and databases for more efficient storage and retrieval of samples. Dana Olzhasovna draws attention to the need for strict regulation of the processing and access to genetic data in order to protect them and ensure confidentiality.

View C: In his opinion, Zhanibek Ualiuli points out the importance of solving the problems associated with differences and the lack of a single standard when working with DNA in the field of criminology. As for Karlygash Sharakhmetovna, she emphasizes the risks associated with violation of procedures for processing and storing DNA materials, which can cause errors and the inability to ensure justice. Daniyar Sabituly's arguments are consistent with C's view, he advocates strengthening oversight of DNA preservation and analysis procedures in forensic centers. Rabiga Zhandarbekkyzy emphasizes the importance of observing ethical and legal norms in the handling of DNA data in criminology. Galimzhan Zholdybekovich focuses on the need for progress and the introduction of innovations in technology to improve the quality and reliability of DNA preservation and analysis processes.

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It is possible to distinguish three groups of opinions of experts from neighboring States.

View A: Ivan Petrovich focuses on the issue of heterogeneity of DNA storage procedures in criminal laboratory practice as a key factor that can distort the results of the analysis. Anna Sergeevna highlights the insufficient training of specialists and gaps in the development of the latest technologies as the main problem when working with DNA. Dmitry Igorevich focuses on the seriousness of the consequences that can result from ignoring ethical standards and protocols in the processing of DNA samples, including possible erroneous outcomes and infringement of individual rights. Elena Alekseevna emphasizes the need for data security guarantees in the process of DNA storage and analysis in order to avoid leaks and abuse. Alexander Vladimirovich points to the problem of lack of funds and resources, which becomes an obstacle to improving laboratories and introducing innovative technologies.

View B: Maria Nikolaevna raises the issue of the limited legal field and legislative framework, which does not correspond to the latest challenges and developments. Pavel Andreevich speaks about the lack of automation in laboratory activities, which reduces its effectiveness. Olga Vasilyevna emphasizes the importance of strengthening international cooperation and information exchange to improve the quality of crime investigation and DNA analysis. Victoria Dmitrievna points out the importance of regular calibration of equipment in laboratories, without which errors in the results are possible. Alexey Viktorovich insists on the development of a unified standard for the storage and analysis of DNA samples, the purpose of which is to standardize working methods in various scientific and legal institutions.

View C: Natalia Alexandrovna highlights the problem of inadequate control and accounting of DNA samples, which sometimes leads to their loss or accidental mixing. Sergey Yurievich notes that the low level of training of specialists becomes an obstacle to high-quality processing of DNA materials. Ekaterina Pavlovna focuses on the need to create a centralized information system for managing DNA data in order to increase the efficiency of their preservation and application. Vladislav Mikhailovich points to the problem of underuse of modern approaches and tools in DNA analysis, which slows down the process of identifying individuals and resolving criminal cases. Tatyana Vladimirovna focuses on the insufficient protection of the physical condition of DNA samples, which leads to the risk of damage or loss.

It is possible to identify three different directions in the opinions of experts from abroad:

View A: Jane Smith highlights the critical lack of finance that hinders work with DNA in forensic laboratories. Robert Brown insists on the creation of

unified standards for the analysis of genetic samples, which guarantees consistency of methods and procedures. Elizabeth Davis focuses on the importance of mechanizing DNA research processes to speed up trials and improve outcomes. Maximilian Johnson addresses the prospects that the latest technologies, in particular mass parallel sequencing, open up to transform the activities of laboratories. Victoria White advocates the development of specialized educational programs aimed at improving the skills of specialists in working with DNA.

View B: Jameson Lee expresses concern about the lack of generally accepted methods in DNA analysis, which complicate the comparison of the results of various studies. Emilia Van Der Woods points out the disregard for quality control and accuracy in DNA analysis, leading to erroneous judgments. Carla Sanchez raises the issue of the need to modernize the technical equipment of laboratories to improve their performance. Isabella Clark draws attention to the problems with the safety of DNA samples associated with inadequate protection of laboratories from external influences. Oliver Brown argues that the introduction of data management systems and information technology can significantly improve the efficiency of DNA analysis.

View C: In the field of DNA preservation and study, as Liam Anderson notes, the key role is played by the creation and application of strict processing and storage procedures that comply with international standards. Noah Taylor focuses on the vital importance of continuous training of laboratory workers in the field of forensic examination in order to stay up to date with the latest advances in DNA analysis techniques and thereby guarantee high quality research. Charlotte Mitchell points out the importance of risk management in the process of handling DNA samples, emphasizing the importance of creating and applying security strategies to eliminate potential threats. Ethan Parker argues that in order to solve the problems associated with DNA preservation and analysis, it is necessary to introduce strict control points and regular monitoring of laboratories. Emma Harris suggests that cooperation between diverse research institutions and forensic laboratories can be a catalyst for knowledge sharing and the development of innovative approaches in DNA analysis.

Results

Based on the first analysis, it became clear that the use of automated techniques in DNA analysis within the framework of forensic research has a significant impact on reducing the time required for conducting examinations. It has been found that such technologies enhance laboratory productivity. Special attention is paid to the fact that automation minimizes the risk of errors related to the human factor, which entails an increase in the accuracy of research. The

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analysis revealed that the introduction of automatic systems contributes to the uniformity of methods, ensuring consistency of results between different laboratories. The study showed that processing large amounts of information becomes more efficient due to automation, which is extremely important in light of the increase in the number of forensic analyses. It is noted that the acceleration of the process of identification of offenders and investigative measures strengthens public safety. The study demonstrates that automation reduces the cost of training specialists and improves the use of laboratory resources. The importance of further development and implementation of automated solutions in forensic activities to enhance its effectiveness is emphasized. The study revealed that automation has the potential to increase the speed of processing requests from justice and law enforcement agencies, contributing to the efficiency of investigations. The findings of the study confirm the idea that automation in DNA analysis can become a fundamental element for modern forensic laboratories in terms of enhancing their efficiency and competitiveness. It was revealed that automation has a positive effect on the quality of laboratory work standards and strengthens confidence in the conclusions of examinations, which is crucial for the judicial and law enforcement systems.

The results of the second research work: Improving the methods of archiving DNA samples in the field of criminology. The work of scientists has revealed that improving the methods of archiving DNA samples leads to minimizing the dangers of spoilage and loss of such samples, which is critical for maintaining their integrity. It has been established that improving storage methods increases the efficiency of using spaces in laboratories engaged in forensic research and helps to reduce the cost of their maintenance. The findings suggest that improved approaches to archiving DNA materials facilitate access to them for subsequent analysis and scientific work. The study identified opportunities to improve storage procedures in the context of improving the safety of laboratory facilities and preventing undesirable situations, including loss or contamination of samples. The revealed results highlight the urgency of creating and adapting advanced solutions and technologies for progressing in DNA archiving and increasing the service life of materials. It has been established that the improvement of archival procedures reduces the time for searching and extracting the necessary samples, which speeds up the work of laboratories. The study showed that improvements in storage contribute to more efficient inventory management and control of the condition of DNA samples, thereby reducing the risk of their loss or spoilage. These studies support the view that improving the storage of DNA samples affects the productivity of forensic laboratories and the quality of analyses performed. It has been found

that optimizing archiving conditions reduces the time required for processing and examining samples, which speeds up responses to requests from law enforcement agencies and judicial authorities. The study confirms the importance of regular monitoring and updating of DNA storage systems to meet modern standards and guarantee their safety.

The third outcome of the research project: Improving the management of information arrays in forensic institutions. The study found that improving information management processes in forensic institutions helps to accelerate and improve the accuracy of data exchange between experts and law enforcement agencies. The advantage of this approach is revealed in increasing the degree of structuring of information arrays, which, in turn, facilitates the process of searching and analytical processing of data necessary for conducting criminal investigations. The results indicate that the quality of expert opinions and the reduction of the time periods required for the analysis of genetic traces directly depend on the competent management of information resources. The study also revealed prospects for the creation of centralized information repositories that simplify access to data for law enforcement officials. Special attention is paid to the role of modern information technologies and software in optimizing the data management process and ensuring their security. It was found that improved information management reduces the time for administrative operations, which increases the speed of response to requests from law enforcement agencies. The analysis showed the importance of developing and implementing standards and regulations for the processing, storage and dissemination of information in forensic institutions. The study indicated that information management plays an important role in optimizing work processes and increasing the efficiency of forensic institutions. It was also revealed that skillful management of information flows contributes to better coordination of actions between individual departments and specialists, which leads to a more effective crime investigation process. The study confirms that effective information management is a key element for improving the efficiency and effectiveness of forensic institutions in the modern environment.

The fourth result of the study: Progress in the Methods of Studying and Understanding the Genetic Code. The research process has shown that progress in the methods of studying and understanding the genetic code enhances the accuracy and stability in establishing genetic profiles. This, in turn, increases the weight of evidence in criminal proceedings. It was found that the improvement of these techniques makes it possible to recognize and take into account a wider range of genetic indicators, which helps to improve the identification procedures of suspects and establish links between evidence. Additionally, the results

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indicate that the development of these approaches increases the detail and sensitivity of analytical tests, making it possible to detect DNA even in small quantities and in complex samples. The study highlighted the potential of innovative technologies, including metagenomic analysis, to expand the horizons of DNA analysis and highlight new informative characteristics useful in solving crimes. The importance of continuing scientific work and developing methods for analyzing and understanding the genetic code in order to improve existing and introduce innovative technologies is also emphasized. It was noted that the improvement of these methods expands the use of genetic profiles in criminology and helps in establishing family ties. The study also confirms the importance of training specialists in the latest methods of DNA analysis and understanding for their effective use in the field of criminology. The conclusions point to the prospects of using machine learning and artificial intelligence to automate analytical processes and enhance the effectiveness of forensic research. It was revealed that the development of methods in the field of genetics leads to an increase in the standards and quality of examinations, which helps to strengthen confidence in the conclusions of experts. The relevance of deepening knowledge in the field of mastering technologies for decoding and understanding the genetic code is undeniable, and it becomes a fundamental aspect for the progress of forensic research, which, in turn, contributes to improving the effectiveness in preventing and solving crimes.

Finalization.

Synergy of forensic laboratories with law enforcement agencies. During the scientific analysis, it was found that coordinated work between forensic units and structures of the law enforcement system contributes to faster data exchange and enhanced coordination of processes in the detection of criminal acts. It is revealed that the establishment of transparent and effective procedures for cooperation between these departments leads to an increase in the quality of analytical work and an increase in the chances of successful completion of criminal trials. The results of the study strengthen the understanding that the interaction of these structures leads to an increased responsiveness to challenges that threaten the well-being of society and order. The study also highlighted the importance of collaboration in terms of the development and implementation of advanced techniques and technological solutions in the crime prevention arena. The need for continuous education and qualification training, both in laboratories and in law enforcement agencies, is emphasized in order to maximize the impact of joint activities. It was revealed that synchronized actions between laboratories and law enforcement agencies have a positive effect on the level of forensic work and strengthen the public's faith

in the fairness of judicial proceedings. In conclusion, the study highlighted the relevance of creating and applying unified standards and procedures to harmonize interactions between forensic and law enforcement agencies. The results of the study confirm the positive impact of such synergy on the overall effectiveness of the fight against illegal actions and strengthening the security of citizens. It has been revealed that the interaction of forensic services with law enforcement agencies helps to reduce the period required for the investigation of crimes, which, in turn, increases the effectiveness of the judicial and legal system. The study highlights the importance of forming and strengthening partnerships between relevant laboratories and law enforcement agencies in the context of intensifying the fight against crime and strengthening the rule of law.

Acknowledgements

Scientific developments undoubtedly play a central role in improving methods and approaches to DNA research. This helps to increase the accuracy and efficiency of forensic work. They expand the understanding of the processes responsible for the preservation of DNA samples, ensuring their long-term and reliable storage. Such work is important to maintain the integrity and reliability of genetic data. New research is helping to identify weaknesses in current DNA processing methods, thereby paving the way for their improvement and optimization. They contribute to the establishment of new norms and protocols in DNA manipulation, which is critically important for maintaining methodological uniformity and improving the quality of analytical procedures. The practical application of these studies has a direct impact on improving the processes of conducting criminal investigations and ensuring justice in court.

However, lack of resources and limited time can significantly affect the comprehensiveness and depth of the analysis. A limited selection of samples or their incomplete compliance with the requirements of the study may affect the possibility of extrapolating the results. The problem is also the lack of an adequate level of standardization of research methods, which complicates the comparison and interpretation of the results. Insufficiently systematic and consistent presentation of the methods may prevent other scientists from reproducing the work. In addition, the accuracy and validity of the data and conclusions obtained may suffer due to methodological limitations or errors in the analysis.

Research in this area opens the door to the creation of innovative methods of DNA analysis and further improvement of established technologies used in criminology. In the process of conducting scientific research, we have a chance to consider in detail the various factors that play a role in the preservation of genetic samples. This knowledge will become the basis for the creation of improved methods of DNA

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conservation and study. The experimental part of the study provides valuable information that contributes to a deep understanding of the mechanisms of analysis of genetic material. The comparison of various approaches and analysis techniques helps to identify their strengths and weaknesses, which undoubtedly benefits in the context of improving the work of forensic experts. The application of scientific developments in the activities of law enforcement agencies and the judicial system directly affects the effectiveness of countering crimes and strengthening the security of society.

On the other hand, the study is fraught with risks, including the possibility of misinterpretation of the results due to limitations in the methodology or errors in the analysis process. The problem of leaking sensitive DNA-related data carries the threat of violating the right to privacy. Ethical issues arise regarding the use of genetic samples to establish identity and family ties without the permission of interested parties. There is also a danger that the results of the study will turn out to be unreliable and inaccurate due to shortcomings in the technologies used. Not the least is the risk of a negative impact on the natural environment as a result of the use of certain chemicals and materials during the analysis of genetic samples.

The research team revealed the prospects for deepening knowledge in the field of forensic examination, offering methods of DNA analysis characterized by increased accuracy and stability. Such approaches enhance detective work. The breakthrough in the preservation and decoding of genetic materials enables the scientific team to move forward, laying the foundation for future discoveries in this field. The data obtained opens up ways to improve methods in criminology, which has a positive effect on the investigation of crimes and strengthens justice in court proceedings. A team of scientists has demonstrated how genetic samples can serve as accurate indicators of personality, contributing to the resolution of criminal cases and strengthening faith in the rule of law. These discoveries also stimulate fruitful interaction between the scientific community and experts in the field of criminology, which facilitates the exchange of knowledge and skills in the field of genetic identification and crime control.

Within the framework of this study, it is possible to discover new directions in genomics concerning DNA connections with various phenotypic traits. The results are expected to deepen understanding of the mechanisms of evolution and development of living organisms, opening horizons for the study of genetic mutations. The study may also contribute to the creation of new therapeutic approaches based on the genetic characteristics of patients and their association with certain diseases. In the process, scientists can discover new techniques in bioinformatics related to the analysis and processing of large amounts of

genetic information. The results of the study may also pave the way for new applications of DNA in various fields, including forensic science, anthropology and medical genetics.

Conclusion

In the final part, the study of the contribution of DNA analysis to the detection of crimes is a topic of considerable relevance and of interest both in scientific and applied aspects. This treatise presents a summary of the latest breakthroughs in detective science, which are associated with the use of genetic research in the process of crime detection. Within the framework of the work, the leading finds and successes in the preservation and examination of DNA materials were identified, as well as their role in the transformation of the modern judicial and legal system. The analysis revealed the main difficulties and obstacles faced by scientists and forensic experts when working with genetic samples. The treatise allowed us to identify new horizons and directions for future research in the field of forensic examination and genetics related to DNA analysis. One of the key findings of the study is the identification of potential dangers and negative consequences that may arise as a result of the use of genetic data in law enforcement. In fact, the work highlights the fundamental need to form an ethical and legal framework regarding the use of DNA for forensic purposes. The treatise also focuses on the importance of the interaction of the scientific community with law enforcement agencies for the successful implementation of genetic research. The main idea of the study is the need for continuous improvement of DNA analysis technologies and techniques to enhance the effectiveness of crime prevention. The conclusion is supported by a careful consideration of literary sources and relevant scientific data in the domain of criminology and genetics. The final provisions emphasize the importance of DNA analysis in modern forensic practices and its importance for achieving justice and ensuring public safety. The discussion of issues related to the preservation and analysis of genetic samples highlights critical aspects that require additional research and development. In conclusion, the treatise draws attention to the importance of taking into account ethical and legal aspects when using genetic analysis in the field of criminology. This scientific review covers the key trends and trajectories of progress in the field of forensic science and genetic research, with an emphasis on the study of DNA. In the final part of the work, the results of analytical work and debates are summarized, with special attention to the importance of the studied issues for the academic community and practitioners. The work is a significant contribution to understanding the contribution of DNA analysis in the field of criminology and its impact on the working methods of law enforcement agencies. Reflections on the issues

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and prospects of using DNA analysis make it possible to develop directions for subsequent scientific research and their practical application. The findings of the study emphasize the importance of an integrated approach to the storage and research of DNA profiles, taking into account the interaction of various scientific

disciplines. The analysis of the problems and challenges associated with DNA diagnostics is aimed at increasing the level of awareness and understanding by the public of the technological and moral aspects of the use of genetic data in criminology.

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