Judicial Chemistry — Current Issues in the Republic of Moldova

Ana-Maria Cisleanu

National Center of Judicial Expertise of the Ministry of Justice of the Republic of Moldova, Chisinau, Republic of Moldova, e-mail: anamariacisleanu@yahoo.com

Svetlana Cotorobai

National Center of Judicial Expertise of the Ministry of Justice of the Republic of Moldova, Chisinau, Republic of Moldova, e-mail: s.cotorobai9@gmail.com

Olga Cataraga

PhD in Law, Doctor of Legal Sciences, National Centre of Judicial Expertise Ministry of Justice of the Republic of Moldova, Chisinau, Republic of Moldova, e-mail: olga.cataraga@justice.gov.md

Forensic chemistry is unique among the chemical sciences in that its research, practice and presentation must meet the needs of both the scientific and legal communities. Forensic chemistry research is therefore applied and derivative in nature and design and emphasises metrology (the science of measurement) and validation. Forensic chemistry has moved away from its analytical roots and incorporates a broader spectrum of chemical sciences. Existing forensic practices are being revised as the scope of forensic chemistry expands from drug analysis and toxicology to areas as diverse as combustion chemistry, materials science, and pattern evidence.

Keywords: forensic chemistry; evidence; examinations; crime; results.

Судова хімія — актуальні питання в Республіці Молдова

Ана-Марія Цисляну, Світлана Которобай, Ольга Катарага

Судова хімія є унікальною серед хімічних наук, оскільки її дослідження, практика і представлення повинні відповідати потребам як наукової, так і юридичної спільноти. Тому дослідження в галузі судової хімії є прикладними і похідними за своєю природою і структурою, а також акцентують увагу на метрології (науці про вимірювання) і валідації. Судова хімія відійшла від свого аналітичного коріння і містить ширший спектр хімічних наук. Чинні судові практики оновлюють, оскільки сфера судової хімії розширюється від аналізу наркотиків і токсикології до таких різноманітних галузей, як хімія горіння, матеріалознавство і докази за зразками.

Ключові слова: судова хімія; докази; експертизи; злочин; результати.

«Chemistry is the foundation of modern forensics»

Forensic expertise is a scientific-practical research activity carried out in civil, criminal or misdemeanour proceedings (hereinafter referred to as judicial proceedings) for the purpose of ascertaining the truth by carrying out methodical research with the application of special knowledge and technical-scientific procedures in order to formulate reasoned conclusions regarding certain facts, circumstances, material objects, phenomena and processes, the human body and psyche, which may serve as evidence in a judicial proceeding [1].

The relation between forensic science and chemistry is that it provides forensic science with a range of technical-scientific means and methods, some of which are specially adapted and refined to meet the needs of the criminal investigation process. While biocriminal, dactyloscopic and graphic forensic examinations are based on the examination of intrinsic characteristics of the individual (papillary drawing, DNA profile), physico-chemical forensic examinations in most cases concern the examination and analysis of elements or characteristics of objects which are related to the circumstances of the crime, in particular those directly linked to the results of the examination [2].

Chemistry is the science that studies the structure, properties and behaviour of matter and the changes it undergoes during chemical reactions. It deals with the analysis of chemicals, how they interact with each other and how they can be transformed. Chemistry is often divided into several fields, such as organic chemistry, inorganic chemistry, physical chemistry and analytical chemistry, each dealing with different aspects of matter and chemical reactions.

Judicial chemistry, as an integral part of forensic science, is that which, through the chemical expertise of the traces of matter left at the scene, provides relevant, decisive evidence to document criminal and civil cases. In the process of forensic investigation of a wide variety of cases, an important role is played by the chemical expert who, by examining and analysing the evidence made available to him, is able to draw pertinent conclusions demonstrating the power of science in the completion of ideas of justice, creating maximum chances of a truthful and fair resolution of any legal case [2].

Forensic chemistry is at the intersection of science and law, and is a discipline unique only in its applicability to the judicial system; by using various methods of analysis, forensic chemistry discovers and documents chemical changes that occur during an incident, thus helping to reconstruct the sequence of events. At the same time, forensic chemistry is unique among the chemical sciences in its research activity, its practical work and the way it presents its results, which must meet the needs of both the scientific and legal communities.

Forensic chemists analyse drugs, paint, metals, glass, explosives, residues from fires and explosions, gunshot residues, fibres, paper, inks, polymers, soil, petroleum products, etc. and the information they provide is used as a starting point to determine the causes and circumstances of various events, to identify the objects involved in various crimes and the persons responsible.

Judicial chemistry performs the most diverse qualitative and quantitative analysis of all forensic disciplines on various chemicals found on people, objects or in solutions. It should be noted that in forensic chemistry, a significant proportion of the methods of analysis are qualitative, while quantitative methods are used for the analysis of evidence collected in drug cases, traffic accidents (paint, glass, soil). Also, forensic chemistry samples are taken from various media found in the crime scene which, for reasons of size, cannot be transported to the laboratory. In most cases, these contain very small quantities of chemical substances, are non-homogeneous and are often impure without the possibility of producing statistically representative samples. This is also a function of the state of aggregation of the sample, the homogeneity of the sample or the compounds sought. Sometimes, however, even forensic chemistry samples can be considered chemically homogeneous and representative samples can be taken (paints, textiles, plastics). Other materials are heterogeneous (soil, building materials, fire residues) [2].

Chemically examined evidence is particularly powerful because the nature, relative abundance, and spatial arrangement of atomic and molecular constituents provide a distinctive signature that can lead to the identification of an object or substance, determine its source of origin, and detect changes in its integrity resulting from structural modification and/or surface contamination.

One of the current problems in the field of forensic chemistry is the risk of contamination/inter-contamination of evidence [2].

Contamination is the impurification of a sample with various external contaminants unrelated to the sample (chemical, biological) resulting in a sample with the characteristics of all contaminated agents together with its original structure.

In forensic chemistry laboratories, possible contamination of samples may have undesirable consequences on the results obtained, as the association of the samples in dispute with the comparison samples may be false positive or false negative, with repercussions on the life and liberty of the persons involved [2].

Example: footwear, papillary, biological traces, hairs, fibres, etc. from persons present at the scene but not connected with the crime.

Intercontamination is the process by which an exchange of material (biological, physical or chemical) is made between two or more individualised samples, resulting in samples that no longer allow for individualisation or that produce a mixture incompatible with determination.

For example, if the victim's clothes collected from the scene and the perpetrator's clothes are packed together in the same package, with the possibility of direct contact between them,

it is no longer possible to determine whether the evidence on the clothes is the result of victim-perpetrator contact during the crime or as a result of contact between the clothes inside the package [2].

The effects of contamination and inter-contamination are the loss of probative value of the evidence and the impossibility to properly expert the evidence.

A skilfully conducted on-site investigation, fully in line with forensic recommendations and in strict compliance with criminal procedural law, provides a sufficiently solid foundation in the evidentiary process. However, the procedural action in question is also an extremely demanding task for the prosecuting body, requiring thorough professional knowledge and skills. These cannot be acquired quickly, in a day or a month of practical work, any more than you can learn to investigate a crime scene by reading forensic textbooks. You can only become a highly qualified specialist by constantly evaluating and comparing your practical crime scene search actions with the scientific recommendations developed by forensic science over a long period of study and generalisation of crime investigation practice [2].

We also note that at present, the forensic specialists of the technical-criminalistic subdivisions experience a permanent shortage of methodical materials, especially those dedicated to on-site investigation and technical-criminalistic materials.

A solid training in chemistry and instrumental analysis is essential, as well as a good training in forensics. A degree in forensic science at both undergraduate and graduate level is recommended. Those interested in working with trace evidence, such as glass, hair and paper, should focus on instrumentation skills and take courses in geology, soil chemistry and materials science. If forensic biology and DNA analysis are preferred, take courses in microbiology, genetics and biochemistry. Those interested in the toxicological aspects of this work should study physiology, biochemistry and chemistry [3].

Another current problem is the lack of qualified specialists in the field of forensic chemistry, because, at the moment, in the Republic of Moldova, a very small number of students are studying in the Faculties of Chemistry, Chemical Technology and Biotechnologies.

Versatility and patience are the most often cited qualities of a forensic chemist. Forensic chemists must be able to spend hours rigorously applying analytical techniques to evidence and defending their work in a court of law. They must provide conclusive evidence and be able to respond clearly and concisely to challenges to their findings. Integrity is also an important characteristic, as often different interests in a case try to influence the position of the forensic chemist [3].

Duties and responsibilities of the chemical forensic expert:

- Collects, analyzes and compares evidence samples in criminal investigations
- Identifies and documents the presence of trace evidence such as hair, fibers and chemicals.
- Use a variety of laboratory instruments and techniques to analyze evidence
- Documents results of analysis clearly and accurately
- Prepare detailed and comprehensive reports of findings
- Testify in court as an expert witness
- Keep detailed and accurate records of evidence and findings
- Ensure that all safety protocols are followed and that all laboratory equipment is properly maintained [4].

Employment prospects

The field of forensic chemistry is cautiously optimistic about future employment prospects. Greater interest in the use of DNA analysis is expected to create jobs. Those interested in DNA work should keep up with rapidly changing technology and develop skills that set them apart from others.

Respectively, after graduating from the nominated universities, young professionals give priority to working in the private sector (industry), as it is better paid.

Those who decide to work in the public sector and choose the field of forensic chemistry are faced with low salaries and a lack of modern equipment, which makes the sector unattractive [5].

Chemistry plays a significant and increasingly important role in forensic science, providing invaluable information about crime scenes and

supporting the investigation of criminal activity. Chemistry is the foundation of forensic science and is used to analyse traces, fingerprints, poisonous compounds, narcotics, accelerants in arson investigations, and even DNA. The importance of chemistry in forensic science will only increase as analytical methods and technology continue to improve, allowing law enforcement organizations to solve complicated crimes and provide justice for victims and their families.

Forensic chemistry is a powerful tool in criminal investigations, combining the rigour of scientific investigation with the pursuit of justice. With technological advances and emerging analytical techniques, its role in solving crime is expected to expand even further.

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