

## Comparison of the Effectiveness of DNA Extraction Methods in Body Identification

**Yevheniia Boichenko**

PhD in veterinary sciences, Chief Forensic Expert of the Molecular Genetic Research Sector of the Department of Biological Research and Accounting, Zaporizhzhia Scientific Research Expert and Forensic Center of the Ministry of Internal Affairs of Ukraine; 1st year master's student, Zaporizhzhia National University, Zaporizhzhia, Ukraine, ORCID: <https://orcid.org/0000-0002-4278-5286>, e-mail: borodai.yevheniia@gmail.com

**Olena Boika**

PhD in Biology (Genetics), associate professor, associate professor of the Department of the Genetics and Plant Resources, Zaporizhzhia National University, Zaporizhzhia, Ukraine, ORCID: <https://orcid.org/0000-0002-1680-6477>, e-mail: olena.boika.ua@gmail.com

*This paper compares DNA extraction methods used in forensic investigations for individual identification. It analyses the advantages and disadvantages of the primary techniques employed in routine forensic examinations at the Zaporizhzhia Scientific and Research Forensic Center of the Ministry of Internal Affairs of Ukraine. Emphasis is placed on the criteria for selecting a specific method, depending on the circumstances and the available biological material.*

**Keywords:** identification of bodies; DNA methods; forensic investigation.

## Порівняння ефективності методів виокремлення ДНК під час проведення ідентифікації тіл

**Євгенія Бойченко, Олена Бойка**

*Наведено порівняння методів виокремлення ДНК під час проведення експертизи з ідентифікації осіб. Розглянуто переваги й недоліки основних методик, якими послуговуються у щоденній роботі із проведення експертиз у Запорізькому науково-дослідному експертно-криміналістичному центрі МВС України. Акцентовано увагу на критеріях вибору конкретного методу залежно від обставин і наявного біологічного матеріалу.*

**Ключові слова:** ідентифікація тіл; ДНК-методи; експертиза.

Currently, the issue of body identification is critically pressing due to the ongoing war. Unfortunately, forensic laboratories across Ukraine are overwhelmed with requests for examinations aimed at identifying the bodies of citizens. Various DNA analysis methods are widely employed for body identification, yet each

has inherent advantages and disadvantages.

Two methods that have found widespread application in the work of experts at the Zaporizhzhia Scientific and Research Forensic Center of the Ministry of Internal Affairs of Ukraine are:

1. DNA extraction using Chelex 100 ion-exchange resin.
2. DNA extraction employing commercial kits containing magnetic particles.

For objects containing degraded DNA (e.g., putrefied, burned human bone remains), specialized commercial kits manufactured by companies such as QIAGEN, GEN-IAL, and MACHEREY-NAGEL are utilized. These kits are especially relevant when the quantity of degraded human biological material is limited and other DNA extraction methods cannot be applied due to objective reasons. Subsequent publications will address further discussion regarding these kits.

The method involving Chelex 100 ion-exchange resin presents several advantages:

- Speed of execution.
- Non-toxic nature.
- Cost-efficiency.
- Direct addition of the resin to the sample.

This technique involves incubating the sample in a Chelex 100 solution followed by boiling. This process destroys cellular membranes and facilitates the removal of proteins and magnesium ions. Consequently, nucleases are inactivated.

A notable advantage of this method is its simplicity, as it involves a limited number of steps, thereby reducing the risk of cross-contamination between DNA samples. DNA remains in the

aqueous supernatant fraction after centrifugation. However, the method's limitation lies in its insufficient DNA purification from protein contaminants, which can act as PCR inhibitors. Thus, when the quantity of the sample material is highly restricted, this method becomes impractical.

The second approach, or rather a group of methods, involves DNA extraction using magnetic particles. Magnetic particles bind DNA molecules due to differences in potential, while proteins, cellular membranes, and inhibitors are precipitated using specific reagents. After the washing step, DNA remains in the eluate buffer fraction, while magnetic particles adhere to the walls of tubes placed on a magnetic rack.

This method yields DNA with higher concentration and purity than the Chelex 100 method. It is particularly suitable for samples containing small quantities of DNA, degraded DNA, and/or inhibited DNA. Presently, several suppliers offer diverse kits for DNA extraction using magnetic particles. The manufacturer's choice depends on the availability of kits for sale, pricing, and user convenience for employees at various institutions.

In summary, the two primary DNA extraction methods are interaction with magnetic particles and the application of Chelex 100 ion-exchange resin. The selection of a specific method for forensic examination depends on the quantity and quality of the available material and the accessibility of extraction kits.