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Comparative Analysis of Indonesian-United States Criminal Evidence Standards: A Study of DNA Evidence as Sole Evidence

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Abstract: This study examines the legal standing of DNA evidence as a sole means of proof within the criminal justice systems of Indonesia and the United States. DNA, known for its scientific reliability and high accuracy in identifying perpetrators, has received substantial recognition in the United States. Under the "beyond a reasonable doubt" standard, DNA evidence in the U.S. can independently substantiate a conviction and serve as the sole basis for a guilty verdict. In contrast, Indonesia's evidentiary framework remains governed by the *negatief wettelijk* principle, which requires at least two valid pieces of evidence supported by the judge's conviction to establish criminal liability. As a result, DNA evidence in Indonesia is generally considered corroborative rather than conclusive and cannot stand alone in court. This research adopts a normative juridical method, combining statutory analysis and conceptual interpretation to assess the legal treatment of DNA evidence in both jurisdictions. The findings emphasize the urgent need for Indonesia to reform its criminal procedure law to accommodate modern scientific evidence, such as DNA, as primary proof in specific cases. Recommendations include amending provisions in the Indonesian Criminal Procedure Code (KUHAP), enhancing forensic infrastructure, strengthening legal regulations, and improving the capacity of law enforcement personnel. With appropriate procedural safeguards and human rights protections, DNA evidence holds significant potential to be recognized as standalone proof within Indonesia's criminal justice system.
Keywords: ***DNA evidence, criminal evidence, Forensics***

1. Introduction

Evidence plays an important role in solving crimes and upholding justice. In the past, witness testimonies and physical evidence were the main determinants in the legal system, mainly due to technological limitations at the time. However, as science and technology developed, scientific evidence began to play an important role in the criminal justice system.[1] Among the various types of evidence, forensic is one of the most crucial because it is able to reveal facts scientifically and objectively. In criminal investigations, forensic evidence helps law enforcement distinguish between perpetrators and victims, and ensures the legal process is fair and accurate.[2]

Forensic evidence plays a crucial role in the process of proving a crime as it can reveal important details about the modus operandi of the crime and identify the perpetrators. Data obtained through forensic analysis not only provides an in-depth scientific picture of a criminal event, but also becomes a legitimate tool to support the judicial process.[3]

[1] Bakhtiar, Handar Subhandi. 2023. "THE ROLE AND NATURE OF EVIDENCE: FORENSIC INSIGHT". *Jurnal Yuridis* 10 (2):10-22. https://doi.org/10.35586/jyur.v10i2.7072.
[2] Ibid.
[3] H. S. Bakhtiar, *"Pentingnya Bukti Forensik pada Pembuktian Tindak Pidana," Jurnal Hukum Pidana dan Kriminologi* 3, no. 2 (2022): 36–43.

The development of forensic technology, particularly DNA evidence, has brought significant changes in the global criminal justice system as it brings a higher level of precision than national evidentiary methods.[4] These advancements have changed the way law enforcement identifies criminals and proves the guilt of defendants in court.[5] However, there are fundamental differences in the application of DNA evidence as sole evidence between the Indonesian and US legal systems.

In the United States, DNA has become a key law enforcement tool with a high degree of certainty in linking offenders to crimes. The Combined DNA Index System (CODIS) is a critical infrastructure that allows forensic laboratories to electronically exchange and compare DNA profiles.[6] Since 2002, thousands of investigations have been successfully completed through the use of this database. The United States Congress has systematically expanded mandatory DNA testing in their criminal justice system, so that DNA evidence can be the primary and in some cases the sole evidence that determines a court's decision.[7]

In Indonesia, although there are existing regulations concerning the use of DNA for identification—namely National Police Chief Regulation No. 12 of 2011 and Regulation No. 5 of 2014—the role of DNA evidence within the national criminal evidentiary system remains restricted According to Article 183 of the Indonesian Criminal Procedure Code (KUHAP), a court may only convict a defendant if there are at least two valid pieces of evidence accompanied by the judge's firm belief in the defendant's guilt. This means that if the legally recognized forms of evidence are insufficient to convincingly establish the accused's culpability, the defendant must be acquitted.[8] This legal approach exemplifies Indonesia's adherence to the negatief wettelijk bewijstheorie (negative statutory evidence theory), which emphasizes a combination of quantitative and qualitative evidentiary thresholds in criminal adjudication.[9]

Indonesia still upholds the principle of quantitative evidence in criminalizing someone, where the number of evidence is an absolute requirement with a minimum provision of two valid evidence as stipulated in Article 183 of the Criminal Procedure Code.[10] This approach is different from the evidentiary system in the United States which emphasizes qualitative aspects, where the quality and evidentiary strength of evidence can be the basis for making a decision, including DNA evidence which has a very high level of accuracy.[11]

In practical application, DNA testing within the Indonesian judicial system is regarded merely as supporting or secondary evidence, rather than as a primary means of proof. Under Indonesian positive law, DNA analysis is generally incorporated into the visum et repertum

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https://jdih.tanjungpinangkota.go.id/data_file/2850/Pentingnya%20Bukti%20Forensik%20Pada%20Pembuktian%20Tindak%20Pidana.pdf

[4] Bakhtiar, H. S. "The Evolution of Scientific Evidence Theory in Criminal Law: A Transformative Insight." *Media Iuris* 7, no. 2 (2024). https://e-journal.unair.ac.id/MI/article/view/51095

[5] Rianti, P., Cristin, E., and Widodo, P. T. 2018. "*Profil DNA Forensik pada Barang Bukti Dua Kasus Pembunuhan di Indonesia.*" Jurnal Sumberdaya Hayati 4(2): 48–56.

[6] Butler, J. M. "The Future of Forensic DNA Analysis." *Philosophical Transactions of the Royal Society B: Biological Sciences* 370, no. 1674 (2015): 20140252.

[7] Garrett, B. "DNA and Due Process." *Fordham Law Review* 78, no. 6 (2010): 2919–2960.

[8] Adiatma Nugroho, and Handar Subhandi Bakhtiar. 2024. "Pembuktian Ilmiah VS Alibi: Bagaimana Ilmu Forensik Mengatasi Tantangan Pembelaan Pada Kasus Raden Adante". *Jembatan Hukum : Kajian Ilmu Hukum, Sosial Dan Administrasi Negara* 1 (4):86-94. https://doi.org/10.62383/jembatan.v1i4.955.

[9] Hamzah, A. *Hukum Acara Pidana Indonesia*. Jakarta: Sinar Grafika, 2008.

[10] Undang-Undang Nomor 8 Tahun 1981 tentang Hukum Acara Pidana (KUHAP), Pasal 183.

[11] Murphy, Erin. "The New Forensics: Criminal Justice, False Certainty, and the Second Generation of Scientific Evidence." *California Law Review* 95, no. 3 (2007): 721–797.

and falls under the category of documentary evidence, as outlined in Article 184 paragraph (1) letter c of the Criminal Procedure Code (KUHAP). Additionally, it may also be interpreted as expert testimony in accordance with Article 184 paragraph (1) letter b. This legal positioning limits the independent evidentiary weight of DNA in criminal proceedings.[12] In stark contrast, the United States accords DNA evidence a significantly more authoritative role within its criminal justice framework, often recognizing it as decisive and sufficient to meet the burden of proof, especially when evaluated under the standard of "beyond a reasonable doubt".

The criminal investigation stage serves as the gateway to the enforcement of criminal law within Indonesia's criminal justice system. As such, the investigation process plays a pivotal role in determining whether a case meets the legal threshold to proceed to prosecution and trial. The effectiveness of this stage is crucial in upholding the core objectives of the legal system justice, legal certainty, and utility while simultaneously adhering to the fundamental principles of delivering justice in a manner that is straightforward, prompt, and cost-efficient.[13]

The evolution of law enforcement systems and practices in Indonesia reflects a growing alignment with the demands of public justice. However, in the realm of evidence, legal procedures remain firmly rooted in the provisions of the Indonesian Criminal Procedure Code (KUHAP). Within this framework, the acceptance of DNA evidence as a sole basis for conviction remains a complex and unresolved issue. This matter warrants deeper examination, particularly through a comparative lens with the United States, where the criminal justice system has made more significant strides in integrating forensic science especially DNA technology into its evidentiary standards. Such a comparison is essential to assess the potential for reform and modernization of Indonesia's evidentiary approach in line with scientific advancements.[14]

Previous studies have shown that the application of DNA evidence in the justice system faces various challenges. Harahap (2021) highlights the unclear position of DNA evidence in Indonesia's evidentiary system, while Butler (2019) underlines the need for legal adaptation to maximize DNA technology. Mnookin (2018) critiques the potential for overreliance on DNA evidence. However, most of these studies are limited to one legal system and have not conducted a comparative analysis between the evidentiary standards in Indonesia and the United States, particularly regarding the use of DNA evidence as sole evidence.

Another limitation of previous research is the lack of exploration of the practical impact of different standards of proof on law enforcement effectiveness. These studies are generally normative in nature and have not touched on aspects such as prosecutorial success, victim satisfaction, and public trust in the justice system. Therefore, this research aims to fill this void by conducting a comprehensive comparative study between Indonesian and United States criminal law regarding the use of DNA evidence as a single piece of evidence. Through an interdisciplinary approach that combines law and forensic science, this research is expected to offer the best recommendations for the optimization of DNA evidence, as well as contribute to the reform of the criminal evidence system in the modern era while upholding the principles of justice and legal certainty.

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[12] Undang-Undang Nomor 8 Tahun 1981 tentang Hukum Acara Pidana (KUHAP), Pasal 184 ayat (1).

[13] Mulyadi, Lilik. *Hukum Acara Pidana: Suatu Tinjauan Khusus Terhadap Surat Dakwaan, Eksepsi, dan Putusan Peradilan*. Bandung: Citra Aditya Bakti, 2012.

[14] Harahap, M. Yahya. *Pembahasan Permasalahan dan Penerapan KUHAP: Pemeriksaan Sidang Pengadilan, Banding, Kasasi, dan Peninjauan Kembali*. Jakarta: Sinar Grafika, 2016.

2. Method

This research applies a normative juridical method, which focuses on examining legal norms to resolve issues related to positive law. It involves a detailed study of legal concepts, doctrines, principles, and relevant statutory regulations.[15] The research is both descriptive aimed at outlining current legal issues and prescriptive designed to offer predictions and formulate recommendations for future legal policies. Through this method, the research seeks to provide theoretical answers based on established legal norms.

The approach used in this study combines statutory and conceptual analysis. The data consists of primary legal materials, such as laws and government regulations, and secondary legal materials, including books, journals, and scholarly articles. Data collection is carried out through literature review, and the analysis is conducted qualitatively. This allows for a comprehensive and systematic interpretation of the legal problems being examined, with the goal of offering clear insights and potential solutions within the Indonesian legal framework.

3. Results and Discussion

3.1 Comparison of the Position of DNA Evidence as a Single Evidence in the Indonesian and United States Criminal Law Evidence Systems in terms of Quantitative and Qualitative Aspects

3.1.1. Analysis of the Role of DNA in Criminal Proceedings in Indonesia

DNA (Deoxyribonucleic Acid) in the context of Indonesian law is scientific evidence for identification purposes in the law enforcement process. Juridically, Forensic DNA is defined as a branch of biological science that studies the utilization of biomolecular technology for identification purposes.[16] DNA evidence has unique and specific characteristics in each individual (except identical twins), so it can identify a person with high accuracy.[17] In the Indonesian evidentiary system, DNA evidence is not explicitly mentioned in KUHAP, but is positioned as part of letter evidence or expert testimony.[18] DNA evidence is complementary and cannot stand alone as a single piece of evidence in the Indonesian evidentiary system which adheres to the principle of a minimum of two pieces of evidence.[19] DNA has high stability and can survive for a long time under certain conditions, allowing analysis on old cases.[20]

DNA testing can be performed on various biological samples such as blood, saliva, sperm, hair and other body tissues.[21] DNA evidence has a dual function, not

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[15] Bambang Sunggono, (2003), Metode Penelitian Hukum, Jakarta, PT Raja Grafindo, Hlm. 32

[16] Peraturan Kapolri Nomor 12 Tahun 2011 tentang Kedokteran Kepolisian, Pasal 1 angka 8.

[17] Atmadja, Djaja Surya. "*Peranan Sidik DNA dalam Bidang Ilmu Kedokteran Forensik*." *Jurnal Kedokteran Forensik Indonesia* 1, no. 1 (2019): 35–42.

[18] M. Yahya Harahap, *Pembahasan Permasalahan dan Penerapan KUHAP: Pemeriksaan Sidang Pengadilan, Banding, Kasasi, dan Peninjauan Kembali* (Jakarta: Sinar Grafika, 2016), 273.

[19] Undang-Undang Nomor 8 Tahun 1981 tentang Hukum Acara Pidana (KUHAP), Pasal 183.

[20] Abdul Mun'im Idries, *Pedoman Praktis Ilmu Kedokteran Forensik* (Jakarta: Binarupa Aksara, 2017), 321.

[21] Rianti, Puji, Elisa Cristin, and Putut Tjahjo Widodo. "Profil DNA Forensik pada Barang Bukti Dua Kasus Pembunuhan di Indonesia." *Jurnal Kedokteran Forensik Indonesia* 2, no. 1 (2020): 15–22.

only identifying the perpetrator of a crime, but it can also exonerate innocent suspects.[22] The regulation of DNA evidence in Indonesia is still limited to technical regulations such as the National Police Chief Regulation, there is no specific law that regulates comprehensively.[23] The interpretation of DNA evidence relies heavily on the expertise and professionalism of forensic experts, thus requiring strict standards and procedures to ensure the validity and reliability of the analysis results in the judicial process.[24]

DNA has a status that is not independent in the Indonesian criminal law evidence system. According to KUHAP Article 184, paragraph (1), witness and expert testimony, as well as letters, directives, and the defendant's own testimony, are all considered forms of admissible evidence.[25] DNA evidence is not explicitly regulated within the provisions of Indonesia's Criminal Procedure Code, and as a result, it is generally treated as part of documentary evidence in the form of a visum et repertum or as expert testimony.[26] Within Indonesia's evidentiary framework, which adheres to the negatief wettelijk bewijstheorie (negative statutory evidence theory), a conviction requires at least two valid pieces of evidence accompanied by the judge's personal conviction, as stipulated in Article 183 of the Criminal Procedure Code.[27] This system places emphasis on the quantity of evidence rather than solely on its probative value. Consequently, despite the high level of scientific accuracy that DNA evidence offers, it cannot independently serve as the sole basis for a criminal conviction under current Indonesian legal standards.

Expert testimony has a crucial role in explaining DNA evidence in court. DNA forensic experts are tasked with explaining the sampling process, analysis methods, interpretation of results, and the level of accuracy of the DNA examination performed.[28] This expert testimony is a bridge that connects complex scientific evidence with the judge's understanding, so that the judge can assess the evidentiary strength of the DNA evidence. In practice, DNA forensic experts must provide testimony under oath at trial to strengthen the results of DNA examination in written form, as stipulated in Article 186 of the Criminal Procedure Code.[29] Achmad S. Soemadipradja emphasized that although DNA tests are quite accurate, their position remains as corroborating or secondary evidence, not primary evidence.[30]

Achmad S. Soemadipradja emphasized that although DNA tests are quite accurate, their position remains as corroborating or secondary evidence, not primary evidence.In Indonesian judicial practice, there are several cases that demonstrate the use of DNA evidence as evidence. The Nasrudin Zulkarnaen

[22] Sapardjaja, Komariah E. "Alat Bukti DNA dalam Proses Penegakan Hukum." *Jurnal Hukum dan Pembangunan* 33, no. 2 (2018): 205–218.
[23] Peraturan Kapolri Nomor 5 Tahun 2014 tentang Pelaksanaan Pelayanan Kesehatan Tertentu di Lingkungan Kepolisian Negara Republik Indonesia, Pasal 22.
[24] Soerjono Soekanto, *Pengantar Penelitian Hukum* (Jakarta: UI Press, 2014), 142.
[25] Undang-Undang Nomor 8 Tahun 1981 tentang Hukum Acara Pidana (KUHAP), Pasal 184 ayat (1).
[26] M. Yahya Harahap, *Pembahasan Permasalahan dan Penerapan KUHAP: Pemeriksaan Sidang Pengadilan, Banding, Kasasi, dan Peninjauan Kembali* (Jakarta: Sinar Grafika, 2016), 273.
[27] Andi Hamzah, *Hukum Acara Pidana Indonesia* (Jakarta: Sinar Grafika, 2018), 256.
[28] Atmadja, Djaja Surya. "Peranan Sidik DNA dalam Bidang Ilmu Kedokteran Forensik." *Jurnal Kedokteran Forensik Indonesia* 1, no. 1 (2019): 35–42.
[29] Undang-Undang Nomor 8 Tahun 1981 tentang Hukum Acara Pidana (KUHAP), Pasal 186.
[30] Achmad S. Soemadipradja, *Pokok-Pokok Hukum Acara Pidana Indonesia* (Bandung: Alumni, 2010), 157.

murder case involving Antasari Azhar is one example where DNA evidence was used to identify the perpetrator.[31] Another case was the murder of Angeline in Bali, where one of the pieces of evidence that supported the charges was DNA evidence from bloodstains on the suspect's clothing.[32] However, in each of these instances, DNA evidence is bolstered by additional evidence, including expert and witness testimony, as well as other evidence in compliance with the Criminal Procedure Code.

3.1.2. Analysis of the Role of DNA in Criminal Proceedings in United States

A key characteristic of DNA evidence in the United States legal system is its ability to link the perpetrator to the crime with a very high degree of accuracy, so it can serve as a single piece of evidence in the criminal evidentiary process.[33] In order to connect evidence from crime sites with criminal DNA samples kept in a national database, the US Congress created the CODIS (Combined DNA Index System) system, which enables local forensic labs to electronically share and compare DNA profiles.[34]

DNA evidence in the United States has specific characteristics that distinguish it from other forms of evidence, namely: (1) it has a very high level of discrimination with a very small probability of a random match, often expressed in a ratio of 1 to several billion; (2) it can survive over long periods of time and in non-ideal environmental conditions, allowing analysis on old cases; (3) it can be used to identify the perpetrator even if only very small amounts are available at the crime scene; and (4) it meets the standard of proof "beyond reasonable doubt" which is the highest standard in the United States criminal justice system. The Justice for All Act of 2004, which broadens the use of DNA testing in the criminal justice system, and the DNA Identification Act of 1994, which establishes the legal foundation for the creation and upkeep of a national DNA database, are two federal laws that regulate the use of DNA evidence in the United States.[35]

The use of DNA as evidence in the United States criminal justice system has undergone significant development since it was first introduced. In the United States, DNA evidence is accepted as the sole evidence to convict a defendant, in contrast to the Indonesian system. Because DNA testing may be used to rule out innocent persons, link criminals to crimes with high certainty, and expedite criminal investigations, the US Congress has methodically extended the use of DNA testing.[36] The FBI's CODIS system is a vital piece of infrastructure that enables electronic DNA profile interchange and comparison

[31] Rianti, Puji, Elisa Cristin, and Putut Tjahjo Widodo. "Profil DNA Forensik pada Barang Bukti Dua Kasus Pembunuhan di Indonesia." *Jurnal Kedokteran Forensik Indonesia* 2, no. 1 (2020): 15–22.
[32] Komariah E. Sapardjaja, "Alat Bukti DNA dalam Proses Penegakan Hukum," Jurnal Hukum dan Pembangunan 33, no. 2 (2018): 205–218.
[33] National Research Council, The Evaluation of Forensic DNA Evidence (Washington, DC: National Academy Press, 2016), 28–35.
[34] DNA Identification Act of 1994, 42 U.S.C. § 14132 (1994).
[35] Justice for All Act of 2004, Pub. L. No. 108-405, 118 Stat. 2260 (2004).
[36] National Research Council, *The Evaluation of Forensic DNA Evidence* (Washington, DC: National Academy Press, 2016), 28.

across local forensic labs, connecting crime scene evidence with criminal DNA samples kept in the database.[37]

The "beyond reasonable doubt" standard of proof in the United States justice system is an important cornerstone in the admissibility of DNA evidence. It is the highest level of proof in the American legal system that requires prosecutors to prove every element of a crime with such high moral conviction that it leaves no reasonable doubt in the mind of the judge.[38] It emphasizes the qualitative nature of evidence, so that a single piece of high-quality evidence such as DNA can form the basis of a conviction without the need for other supporting evidence. In the context of DNA evidence, this standard is met through a convincing statistical explanation of the probability of a DNA match, thus effectively removing reasonable doubt.[39]

A New York court ruled in People v. Wesley (1994) that DNA evidence can satisfy the level of proof beyond a reasonable doubt and satisfies the Frye standard for the admissibility of scientific evidence.[40] The case of Daubert v. Merrell Dow Pharmaceuticals (1993) strengthened the ability of DNA evidence to meet the beyond reasonable doubt standard by requiring judges to consider methodology, error rates, peer review, and general acceptance within the scientific community. This further established stringent criteria for scientific evidence, including DNA.[41] The use of DNA databases in the criminal justice system was expanded after the US Supreme Court decided in the 2013 case of Maryland v. King that collecting DNA from suspects who have been arrested for serious crimes is permissible and does not violate the Fourth Amendment.[42]

Table 1. Comparison of the Position of DNA Evidence as Sole Evidence in Indonesian and United States Criminal Law Evidence

Aspect	Indonesia	United States
Position in the Evidence System	Cannot stand alone as a single piece of evidence; complementary in nature	Admissibility as sole evidence to convict the defendant
Legal Basis	Not explicitly mentioned in KUHAP; positioned as part of letter evidence or expert testimony.	Governed by various federal laws, including the DNA Identification Act of 1994 and the Justice for All Act of 2004.
Principle of Proof	*Negatief Wettelijk bewijstheorie* (at least two pieces of evidence	Beyond Reasonable Doubt

[37] John M. Butler, *Fundamentals of Forensic DNA Typing* (Academic Press, 2010), 259.
[38] William Blackstone, *Commentaries on the Laws of England* (Oxford: Clarendon Press, 1769), Book IV, Chapter 27.
[39] David H. Kaye, The Double Helix and the Law of Evidence (Harvard University Press, 2010), 132.
[40] People v. Wesley, 83 N.Y.2d 417, 633 N.E.2d 451 (1994).
[41] Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579 (1993).
[42] Maryland v. King, 569 U.S. 435 (2013)

	accompanied by the judge's belief)	
Emphasizing the Evidentiary System	Quantitative (specifying the amount of evidence)	Qualitative (emphasizes quality of evidence)
DNA Database	There is no comprehensive national database system	Has CODIS (Combined DNA Index System) that allows forensic laboratories to exchange and compare DNA profiles electronically
Technical Arrangements	Limited to technical regulations such as the Chief of Police Regulation	Have a comprehensive legal framework at the federal level
Position in the Evidence Hierarchy	As corroborative or secondary evidence, not primary evidence	Can be primary evidence with the highest level of proof

The comparison between the criminal evidence systems of Indonesia and the United States reveals a fundamental difference in the treatment of DNA evidence as a sole means of proof. In Indonesia, DNA evidence does not yet hold an independent position, as the country adheres to the negatief wettelijk stelsel, which requires a minimum of two valid pieces of evidence supported by the judge's conviction to establish guilt. DNA is classified either as documentary evidence or expert testimony, making it supplementary in nature and unable to stand alone in court. Moreover, the regulatory framework is limited to technical regulations, such as police regulations, without comprehensive legal statutes specifically addressing the legal status and evidentiary weight of DNA. This reflects a quantitative approach, where the number of pieces of evidence is a mandatory requirement in criminal proceedings.

In contrast, the United States treats DNA evidence as primary evidence that can stand alone in proving a defendant's guilt. Guided by the "beyond a reasonable doubt" standard, the U.S. legal system emphasizes the quality of evidence rather than its quantity. DNA is considered scientifically robust, with an extremely low probability of error, making it sufficient to meet the highest standard of proof. Supported by advanced infrastructure like the CODIS database and comprehensive federal legislation such as the DNA Identification Act of 1994 and the Justice for All Act of 2004, DNA evidence has strong legal and procedural legitimacy in American courts.

Thus, it can be affirmed that Indonesia adopts a quantitative evidentiary model, focusing on the number of admissible evidences, whereas the United States follows a qualitative approach, prioritizing the strength and scientific

reliability of the evidence. This distinction directly affects the admissibility of DNA as sole evidence in criminal trials and illustrates how each country's legal system responds to advancements in forensic science.

3.2 Prospects for the Development of the Criminal Evidence System in Indonesia Related to the Use of DNA Evidence as a Single Evidence Referring to the Experience of the United States of America

According to Article 183 of the Criminal Procedure Code, the negatief wettelijk stelsel system, which is the basis for Indonesia's criminal evidence system, calls for a minimum of two pieces of evidence along with the judge's opinion.[43] Because DNA can only be used as part of letter evidence or expert testimony, as specified in Article 184 of KUHAP, this method restricts the use of DNA evidence as solo evidence.

According to Achmad S. Soemadipradja, proof through DNA testing can be categorized as evidence whose authenticity is quite accurate, but cannot be the only evidence used in the trial.[44] The position of DNA testing is only as corroborating evidence or secondary evidence, not primary evidence. In Indonesian judicial practice, DNA evidence does not yet have a strong position as independent evidence. Andi Hamzah emphasized that the evidentiary system in Indonesia is still very much bound by the limitative provisions in the Criminal Procedure Code which do not explicitly accommodate the development of modern forensic technology.[45] This causes DNA evidence, which scientifically has a very high level of accuracy, cannot stand alone in criminal evidence. According to Indriyanto Seno Adji, the weakness of Indonesia's evidentiary system lies in its inability to accommodate the development of science and technology in criminal evidence.[46]

The "beyond reasonable doubt" standard, which emphasizes the quality of evidence to eliminate reasonable doubt, is followed by the evidential system in the United States. Through the Justice for All Act of 2004 and the DNA Identification Act of 1994, the US Congress has methodically increased the scope of required DNA testing.[47] As a result, DNA has emerged as a crucial tool for law enforcement, allowing them to positively identify criminals, eliminate suspects, and expedite criminal investigations. In order to connect evidence from crime scenes with offender DNA samples kept in a national database, local forensic labs can electronically exchange and compare DNA profiles thanks to the CODIS (Combined DNA Index technology) technology, which was created in the United States. Butler claims that DNA evidence has an extremely low random match probability often ranging from 1 to several billion and a very high degree of discriminating.[48] In the US, DNA evidence is therefore the "gold

[43] Undang-Undang Nomor 8 Tahun 1981 tentang Hukum Acara Pidana (KUHAP), Pasal 183.
[44] Achmad S. Soemadipradja, Pokok-Pokok Hukum Acara Pidana Indonesia (Bandung: Alumni, 2009), 124.
[45] Andi Hamzah, *Hukum Acara Pidana Indonesia* (Jakarta: Sinar Grafika, 2018), 256.
[46] Indriyanto Seno Adji, *Korupsi dan Pembuktian Terbalik* (Jakarta: Kantor Pengacara dan Konsultan Hukum Prof. Oemar Seno Adji, 2006), 78.
[47] DNA Identification Act of 1994, 42 U.S.C. 14132 (1994). & Justice for All Act of 2004, Pub. L. No. 108-405, 118 Stat. 2260 (2004).
[48] John M. Butler, Advanced Topics in Forensic DNA Typing: Methodology (Academic Press, 2012), hlm. 36.

standard" for criminal proof. The 1994 People v. Wesley case marked a significant turning point in the US legal system's adoption of DNA evidence as major evidence.[49] The court in this instance recognized DNA evidence as trustworthy and legitimate from a scientific standpoint.

Indonesia already has several legal bases that can serve as an initial foothold for the development of a DNA-based evidentiary system. National Police Chief Regulation No. 12/2011 on Police Medicine regulates forensic DNA as a branch of science that studies the utilization of biomolecular science and technology in the field of DNA for identification purposes.[50] Furthermore, National Police Chief Regulation No. 5/2014 on the Implementation of Certain Health Services regulates DNA examination for the Criminal DNA Database and DNA examination for investigation and prosecution.[51] Constitutional Court Decision No. 46/PUU-VIII/2010 has also opened up opportunities for the use of science and technology (including DNA testing) as evidence in certain contexts, particularly in cases of determining a child's civil relationship with his biological father.[52] According to Djaja S. Atmadja, the use of DNA testing in legal cases in Indonesia is not new and has successfully resolved several complex cases such as the identification of disaster victims and murder cases.[53]

The development of an evidentiary system that accommodates DNA evidence as sole evidence in Indonesia faces several challenges. First, limited infrastructure and human resources in the field of DNA forensics. According to Yoni Fuadah Syukriani, Indonesia still lacks accredited DNA forensic laboratories and competent experts in this field.[54] Second, there is no specific regulation governing the use of DNA evidence in the criminal justice process as a single piece of evidence. Third, there is limited budget for the development of a comprehensive national DNA database. However, the opportunity to develop a DNA-based evidentiary system in Indonesia is also very promising. According to Eddy O.S. Hiariej, the development of science and technology must be accommodated in the evidence system to increase the effectiveness of law enforcement.[55] Romli Atmasasmita argues that the reform of Indonesia's criminal procedure law should take into account global developments in the field of forensics, including the use of DNA evidence.[56]

To develop an evidentiary system that accommodates DNA evidence as a standalone means of proof, Indonesia needs to adopt several strategies. First, the reformulation of evidentiary provisions in the Criminal Procedure Code (KUHAP) is necessary to incorporate scientific evidence, including DNA. According to Mardjono Reksodiputro, the reform of KUHAP should take into

[49] People v. Wesley, 83 N.Y.2d 417, 633 N.E.2d 451 (1994).
[50] Peraturan Kapolri Nomor 12 Tahun 2011 tentang Kedokteran Kepolisian, Pasal 1 angka 8.
[51] Peraturan Kapolri Nomor 5 Tahun 2014 tentang Pelaksanaan Pelayanan Kesehatan Tertentu, Pasal 22 ayat (1).
[52] Putusan Mahkamah Konstitusi Nomor 46/PUU-VIII/2010 tentang Pengujian Pasal 43 ayat (1) UU Perkawinan.
[53] Djaja S. Atmadja, "Tes DNA sebagai Alat Bukti dalam Perkara Pidana," Jurnal Hukum dan Pembangunan 41, no. 2 (2011): 188.
[54] Yoni Fuadah Syukriani, Forensik DNA dan Aplikasinya dalam Sistem Peradilan Pidana (Bandung: Sagung Seto, 2016), 145.
[55] Eddy O.S. Hiariej, Teori dan Hukum Pembuktian (Jakarta: Erlangga, 2012), 98.
[56] Romli Atmasasmita, Sistem Peradilan Pidana Kontemporer (Jakarta: Kencana, 2010), 67.

account advancements in modern forensic technology.[57] Second, the development of a national DNA database, similar to CODIS in the United States. Third, the standardization of forensic laboratories and DNA testing procedures to ensure the quality and reliability of DNA evidence. The development of a DNA-based evidentiary system in Indonesia must also consider aspects of privacy and genetic data protection. According to Muladi, criminal law reform must take into account the balance between the interests of the state, society, and the individual.[58] Therefore, the development of specific regulations governing the use of DNA evidence must be accompanied by adequate mechanisms for the protection of human rights.

The experience of the United States in developing a DNA-based evidence system offers several important lessons for Indonesia. First, it highlights the importance of investing in infrastructure and human resources in the field of DNA forensics. Second, it underscores the need for comprehensive regulations governing the use of DNA evidence in judicial processes. Third, it emphasizes the importance of balancing effective law enforcement with the protection of human rights. According to Michael Lynch, the success of the DNA-based evidence system in the United States cannot be separated from adequate political support and funding.[59] In addition, collaboration among law enforcement agencies, academics, and forensic practitioners is also a key factor in the successful development of the system. Indonesia can learn from this experience by establishing similar cooperation among the Police, the Attorney General's Office, the Supreme Court, universities, and forensic institutions.

An example of the use of DNA in criminal evidence in Indonesia can be seen in the research conducted by Puji Rianti, Elisa Cristin, and Putut Tjahjo Widodo, which reveals the use of evidence samples from the DNA Laboratory of the Medical and Health Center of the Indonesian National Police (Pusdokkes Polri).[60] In the murder case they studied, biological material from the crime scene was analyzed to identify the perpetrator. In addition, in Court Decision Number 216/Pid.Sus/2016/PN Rkb, the results of DNA examination from the DNA Laboratory of the National Police Medical and Health Center became important evidence showing the biological relationship between the defendant and the victim, so the defendant was convicted of committing the crime of "child murder".[61] These cases show that DNA evidence has begun to be used in the Indonesian criminal justice system, although it is still as supporting evidence and cannot stand alone as a single piece of evidence.

The prospect of developing a criminal evidence system in Indonesia that accommodates DNA evidence as a single piece of evidence is promising considering the experience of the United States. Despite facing several challenges, Indonesia has already laid the groundwork through various

[57] Mardjono Reksodiputro, Sistem Peradilan Pidana Indonesia: Peran Penegak Hukum Melawan Kejahatan (Jakarta: Pusat Pelayanan Keadilan dan Pengabdian Hukum UI, 2007), 112.
[58] Muladi, Demokratisasi, Hak Asasi Manusia, dan Reformasi Hukum di Indonesia (Jakarta: The Habibie Center, 2002), 56.
[59] Michael Lynch, Truth Machine: The Contentious History of DNA Fingerprinting (Chicago: University of Chicago Press, 2010), 204.
[60] Puji Rianti, Elisa Cristin, and Putut Tjahjo Widodo, "Profil DNA Forensik pada Barang Bukti Dua Kasus Pembunuhan di Indonesia," Jurnal Kedokteran Forensik Indonesia 20, no. 1 (2018): 45.
[61] Putusan Pengadilan Nomor 216/Pid.Sus/2016/PN Rkb.

regulations and court decisions that recognize the importance of DNA evidence in the judicial process. With the reformulation of evidence provisions in Criminal Procedure Code, the development of a national DNA database, and the standardization of forensic laboratories, Indonesia can improve the effectiveness of law enforcement through the use of DNA evidence as the main evidence in the criminal evidence system. However, this development must still pay attention to the basic principles of the Indonesian legal system and the balance between the interests of law enforcement and the protection of human rights.

In addition to reformulating the KUHAP and strengthening forensic infrastructure, Indonesia also needs to strictly apply the chain of custody principle in every process of handling DNA evidence. This principle regulates the flow of collection, storage, and presentation of DNA evidence to prevent contamination, falsification, or misuse. Strict application of the chain of custody will increase the credibility of DNA evidence in the eyes of the law and allow this evidence to be used independently in the evidentiary process. National standard operating procedures (SOPs) related to the handling of DNA evidence should be developed with reference to international practices, and all parties involved in the judicial process must be given adequate training.

Furthermore, it is also necessary to establish or strengthen an independent forensic institution that is not under the control of law enforcement institutions such as the police or the prosecutor's office. This institution must have the authority to objectively verify or retest DNA evidence, including in the post-conviction stage. Post-conviction DNA testing mechanisms are important to provide access to justice for convicts who may be victims of wrongful arrest or wrongful conviction. With an independent institution, the integrity of scientific evidence can be maintained and public confidence in the justice system increased.

Finally, education and training for judges, prosecutors and investigators on the interpretation and use of scientific evidence such as DNA is crucial. Without adequate understanding, scientifically valid DNA evidence may be misinterpreted or ignored in the judicial process. Therefore, the integration of modern forensic materials into legal education curricula and regular training for law enforcement officers should be part of the reform of the evidentiary system. With this holistic approach through legal reform, institutional strengthening, technical procedures and human resource capacity building DNA evidence can be recognized as the sole valid and reliable evidence in the Indonesian criminal law system.

In its application, DNA sampling from suspects must be carried out by order of a judge, not solely at the initiative of the investigator. This provision is important to maintain legality and protect the rights of suspects from arbitrary actions. With an official order from a judge, the sampling process has a strong legal basis and provides a guarantee that the procedure is carried out legally and proportionally. In addition, suspects should also be given the right to refuse sampling without a court order, as well as the right to request retesting by an independent body if necessary.

In its applic to enable the use of DNA evidence as independent evidence in the Indonesian criminal evidence system, it is necessary to formulate strict

conditions so as not to cause misuse or misjudgment. The first requirement is the absence of other evidence that contradicts the DNA results, whether in the form of witness testimony, other evidence, or the defendant's alibi. Second, DNA identification results must show a 100% match without a doubt, so as to eliminate the possibility of the involvement of other parties statistically and scientifically. Third, the DNA testing process must be carried out by at least two independent accredited laboratories, to ensure objectivity and avoid technical errors or data manipulation. By meeting these high scientific and procedural standards, DNA evidence can have very strong evidentiary power even without the support of other evidence action, DNA sampling from suspects must be carried out by order of a judge, not solely at the initiative of the investigator. This provision is important to maintain legality and protect the rights of suspects from arbitrary actions. With an official order from a judge, the sampling process has a strong legal basis and provides a guarantee that the procedure is carried out legally and proportionally. In addition, suspects should also be given the right to refuse sampling without a court order, as well as the right to request retesting by an independent body if necessary.

DNA evidence can be considered as independent evidence in certain circumstances, especially in cases that rely heavily on biological evidence and have no direct witnesses. For example, in rape or murder cases where the victim is unable to testify and there are no eyewitnesses, but biological samples are found at the crime scene that can be scientifically linked to the perpetrator. In addition, in cases of identifying unidentified remains or proving biological relationships (e.g. in cases of abandoned babies or biological family disputes in criminal cases), DNA evidence can be the only objective scientific means of uncovering the material truth.

Therefore, it is important for Indonesia to open up space in the KUHAP for the recognition of DNA evidence as the sole evidence in these special circumstances. Its application must still be accompanied by strict supervision and fair legal procedures, such as taking samples with the permission of the court, the defendant's right to request retesting, and guarantees for the protection of personal genetic data. Thus, DNA evidence not only serves as an evidentiary tool, but can also become a major pillar in upholding justice in a scientific and transparent manner.

4. Conclusion

The fundamental difference between the Indonesian and US evidentiary systems is the position of DNA evidence as the sole evidence. Indonesia adheres to the negatief wettelijk system which requires a minimum of two pieces of evidence and the judge's belief. This makes DNA evidence only as secondary evidence in the form of letter evidence which must be accompanied by expert testimony. Meanwhile, the United States uses the "beyond reasonable doubt" standard which allows DNA evidence with a high level of accuracy to serve as the sole evidence for conviction. Indonesia is more oriented towards quantitative aspects, while the United States focuses on the quality of evidence.

Lessons learned from the United States include the importance of investment in DNA forensics, the need for comprehensive regulation, and the balance between law enforcement and human rights protection. The CODIS system in the United States, which enables the electronic exchange of DNA profiles, could also be an adaptive model for Indonesia. If Indonesia wants to adopt this, it faces challenges such as limited infrastructure and forensic experts, the absence of specific regulations, and the lack of a national DNA database.

Based on National Police Chief Regulation No. 12/2011 on Police Medicine and Constitutional Court Decision No. 46/PUU-VIII/2010, which has created chances for the application of DNA technology, there is a good chance that Indonesia will build a DNA evidence system. The creation of independent forensic institutions, the implementation of chain of custody, the creation of a national DNA database, the reformulation of the Criminal Procedure Code's evidence provisions, and enhancing the proficiency of law enforcement personnel are some suggested actions that the government can take in response to this development. To make DNA evidence as an independent evidence, strict requirements are needed such as the absence of contradictory evidence, 100% match, and testing by at least two accredited independent laboratories.

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