INDIAN JOURNAL OF LEGAL REVIEW

VOLUME 6 AND ISSUE 3 OF 2026

INSTITUTE OF LEGAL EDUCATION

INDIAN JOURNAL OF LEGAL REVIEW

APIS – 3920 – 0001 | ISSN - 2583-2344

(Open Access Journal)

Journal's Home Page – https://ijlr.iledu.in/

Journal's Editorial Page - https://ijlr.iledu.in/editorial-board/

Volume 6 and Issue 3 of 2026 (Access Full Issue on - https://ijlr.iledu.in/volume-6-and-issue-3-of-2026/)

Publisher

Prasanna S,

Chairman of Institute of Legal Education

No. 08, Arul Nagar, Seera Thoppu,

Maudhanda Kurichi, Srirangam,

Tiruchirappalli – 620102

Phone : +91 73059 14348 - info@iledu.in / Chairman@iledu.in

INDIAN JOURNAL OF LEGAL REVIEW [IJLR – IF SCORE – 7.58]

VOLUME 6 AND ISSUE 3 OF 2026

APIS – 3920 - 0001 *(and)* ISSN - 2583-2344

Published by

Institute of Legal Education

https://iledu.in

FORENSIC DNA FINGERPRINTING : RELIABILITY AND LEGAL ADMISSIBILITY IN INDIA

AUTHOR – JACOB JOE JEROME. E* & SUGITH KUMAR**

*STUDENT AT SCHOOL OF EXCELLENCE IN LAW, TNDALU, CHENNAI

** PROFESSOR AT SCHOOL OF EXCELLENCE IN LAW, TNDALU, CHENNAI

BEST CITATION – JACOB JOE JEROME. E & SUGITH KUMAR, FORENSIC DNA FINGERPRINTING : RELIABILITY AND LEGAL ADMISSIBILITY IN INDIA, *INDIAN JOURNAL OF LEGAL REVIEW (IJLR)*, 6 (3) OF 2026, PG. 464-475, APIS – 3920 – 0001 & ISSN - 2583-2344.

ABSTRACT:

DNA fingerprinting, also known as DNA profiling, is one of the most important scientific developments in modern forensic science. It refers to the process of identifying individuals based on unique patterns in their deoxyribonucleic acid (DNA). Since every individual, except identical twins, possesses a distinct genetic profile, DNA analysis has become a powerful tool in criminal investigations, paternity disputes, disaster victim identification, and other legal proceedings. The technique was first developed by Alec Jeffreys in 1984, which revolutionized forensic identification across the world. In India, the advancement of DNA fingerprinting was significantly influenced by the pioneering work of Lalji Singh, who developed indigenous DNA profiling techniques suited to Indian conditions.

Within the Indian legal system, the admissibility of DNA evidence is primarily recognized under the provisions of the Indian Evidence Act, 1872, particularly Sections 45 and 51 relating to expert opinion. Over the years, Indian courts have increasingly relied on DNA evidence in criminal and civil matters, including rape cases, murder investigations, and paternity disputes. Judicial decisions such as Selvi v. State of Karnataka and Nandlal Wasudeo Badwaik v. Lata Nandlal Badwaik demonstrate the growing recognition of DNA profiling as reliable scientific evidence.

Despite its high accuracy and evidentiary value, the use of DNA fingerprinting in India faces several challenges. These include inadequate forensic infrastructure, delays in laboratory analysis, lack of trained personnel, and concerns regarding privacy and misuse of genetic data. Furthermore, the absence of a comprehensive legal framework governing DNA technology creates regulatory gaps. Therefore, strengthening forensic facilities, ensuring proper procedural safeguards, and implementing clear legislative guidelines are essential for enhancing the reliability, admissibility, and ethical use of DNA evidence in the Indian criminal justice system.

INTRODUCTION:

DNA fingerprinting, also known as DNA profiling, is one of the most significant scientific advancements in modern forensic science. It refers to the process of identifying an individual based on unique patterns in their deoxyribonucleic acid (DNA). Since every individual (except identical twins) possesses a distinct genetic makeup, DNA analysis has become a powerful tool in criminal investigation, paternity disputes, disaster victim identification, and other legal proceedings. In the Indian context, DNA fingerprinting has gradually evolved into a crucial evidentiary mechanism, strengthening the administration of justice by enhancing accuracy and reliability in fact-finding.

INDIAN JOURNAL OF LEGAL REVIEW [IJLR – IF SCORE – 7.58]

VOLUME 6 AND ISSUE 3 OF 2026

APIS – 3920 - 0001 *(and)* ISSN - 2583-2344

Published by

Institute of Legal Education

https://iledu.in

The scientific foundation of DNA fingerprinting lies in the discovery of variable regions in human DNA, particularly short tandem repeats (STRs), which differ significantly among individuals. The technique was first developed by Alec Jeffreys in 1984, revolutionizing forensic science worldwide. In India, the application of DNA technology began gaining momentum in the late 1980s and early 1990s, with the establishment of specialized institutions such as the Centre for DNA Fingerprinting and Diagnostics (CDFD) and the Central Forensic Science Laboratory (CFSL)

In the Indian legal system, DNA fingerprinting is not explicitly codified under a single comprehensive statute; however, its admissibility is recognized under the Indian Evidence Act, 1872, particularly Sections 45 and 51, which allow expert opinion as relevant evidence. Courts have increasingly relied on DNA evidence as a form of expert testimony, especially in cases involving rape, murder, disputed paternity, and identification of unknown bodies. The judiciary has acknowledged the high probative value of DNA evidence, often considering it more reliable than traditional forms of evidence such as eyewitness testimony, which may be subject to human error or bias.

Despite its numerous advantages, the use of DNA fingerprinting in India faces several challenges. These include lack of uniform infrastructure across forensic laboratories, delays in processing samples, inadequate training of personnel, and issues related to chain of custody. Additionally, concerns about privacy, consent, and ethical use of genetic data continue to be subjects of legal and academic discourse. The absence of a comprehensive legal framework further complicates the standardization and regulation of DNA-based evidence. Quality assurance and standardization are essential components of the scientific foundation of DNA profiling.

HISTORIC DEVELOPMENT IN INDIA:

The development of DNA fingerprinting in India marks a significant transition in the country's forensic science landscape, moving from conventional investigative techniques to scientifically robust methods of identification. The journey began in the late 1980s, inspired by global advancements in molecular biology and forensic genetics, particularly following the groundbreaking discovery of DNA profiling by Alec Jeffreys in 1984. India's adoption of this technology was relatively swift compared to other developing nations, owing to the proactive efforts of Indian scientists and research institutions.

The pioneering figure in the Indian context is Lalji Singh, often referred to as the "Father of DNA Fingerprinting in India." In 1987, Dr. Singh successfully developed an indigenous DNA fingerprinting technique based on Banded Krait Minor (BKM) satellite DNA. This innovation was crucial because it adapted DNA profiling to Indian conditions, making it more accessible and cost-effective. His work laid the foundation for the application of DNA technology in forensic investigations and judicial proceedings in India.

One of the earliest institutional developments was the establishment of the Centre for DNA Fingerprinting and Diagnostics (CDFD) in Hyderabad in 1990, under the Department of Biotechnology, Government of India. The CDFD became a premier institution for DNA research, diagnostics, and forensic applications. It played a vital role in standardizing DNA profiling techniques, training forensic experts, and assisting law enforcement agencies across the country. Alongside CDFD, laboratories such as the Central Forensic Science Laboratory (CFSL) began incorporating DNA analysis into their investigative processes.

The first major forensic application of DNA fingerprinting in India occurred in criminal and civil cases during the late 1980s and early 1990s. One of the landmark cases was **Queen Empress v. Pitchaikannu (1988)**, which is often cited as one of the earliest instances where

INDIAN JOURNAL OF LEGAL REVIEW [IJLR – IF SCORE – 7.58]
VOLUME 6 AND ISSUE 3 OF 2026
APIS – 3920 - 0001 *(and)* ISSN - 2583-2344
Published by
Institute of Legal Education
https://iledu.in

scientific evidence began influencing judicial reasoning, although DNA evidence itself was not yet fully established. Soon after, DNA fingerprinting was formally introduced in Indian courts in cases such as **State of Tamil Nadu v. Nalini (Rajiv Gandhi Assassination Case)**, where forensic techniques, including DNA analysis, played a crucial role in identifying victims and linking evidence.

DNA FINGERPRINTING AND FORENSICS:

DNA fingerprinting, also known as DNA profiling, is one of the most significant advancements in modern forensic science. It refers to the process of identifying individuals based on unique patterns in their deoxyribonucleic acid (DNA). Except for identical twins, every individual possesses a distinct DNA sequence, making it a powerful tool for personal identification in criminal investigations, civil disputes, and disaster victim identification.

The technique was first developed by Alec Jeffreys in 1984, revolutionizing forensic science by introducing a reliable and scientifically validated method of linking suspects to biological evidence such as blood, hair, saliva, and semen [1138] . In India, DNA fingerprinting gained prominence through the pioneering efforts of Lalji Singh, who is often referred to as the

"Father of DNA Fingerprinting in India."

DNA fingerprinting has transformed the criminal justice system by enhancing the accuracy of investigations, reducing wrongful convictions, and strengthening evidentiary standards. It is widely used in criminal cases, paternity disputes, missing person identification, and mass disaster investigations. In India, the development and application of DNA profiling were pioneered by Lalji Singh, who established its scientific and forensic relevance.[1139] DNA fingerprinting plays a crucial role in criminal justice by linking suspects to crime scenes, identifying victims, resolving paternity disputes, and exonerating innocent individuals. Its growing acceptance in courts reflects its scientific credibility and evidentiary value. DNA fingerprinting plays a crucial role in criminal justice by linking suspects to crime scenes, identifying victims, resolving paternity disputes, and exonerating innocent individuals. Its growing acceptance in courts reflects its scientific credibility and evidentiary value.

SCIENTIFIC BASIS OF DNA IN FORENSIC SCIENCE:

The scientific foundation of DNA profiling lies in molecular genetics, population genetics, and biochemical analysis. DNA (deoxyribonucleic acid) serves as the hereditary material in humans and encodes genetic instructions that determine biological characteristics. In forensic science, DNA analysis is not concerned with the entire genome but focuses on specific polymorphic regions that vary significantly among individuals. These variable regions provide the basis for individualization and identification in criminal investigations.

Principles of DNA Typing Techniques

The reliability of forensic DNA analysis depends on well-established molecular biology techniques.

Restriction Fragment Length Polymorphism (RFLP)

RFLP was one of the earliest methods used in forensic DNA typing. Though accurate, this method requires relatively large and undegraded DNA samples and is time-consuming. It involves cutting DNA with restriction enzymes at specific sequences and separating fragments by gel electrophoresis. Differences in fragment lengths reveal polymorphisms.[1140]

[1138] Alec J. Jeffreys et al., Individual-Specific "Fingerprints" of Human DNA, 316 Nature 76 (1985).
[1139] Lalji Singh, DNA Fingerprinting: Its Applications in Forensic Science, 27 Current Sci. 32 (1991)

[1140] Kary B. Mullis, The Unusual Origin of the Polymerase Chain Reaction, 262 Sci. Am. 56 (1990). [12] John M. Butler, *Forensic DNA Typing* 102 (2d ed. 2005).

INDIAN JOURNAL OF LEGAL REVIEW [IJLR – IF SCORE – 7.58]

VOLUME 6 AND ISSUE 3 OF 2026

APIS – 3920 - 0001 *(and)* ISSN - 2583-2344

Published by

Institute of Legal Education

https://iledu.in

Polymerase Chain Reaction (PCR) : PCR, developed by Kary Mullis, revolutionized forensic science by enabling amplification of minute DNA quantities.[11] Through thermal cycling, DNA segments are exponentially replicated, allowing forensic scientists to analyze even degraded or trace samples. PCR-based techniques form the backbone of modern forensic DNA analysis.

Short Tandem Repeat (STR) Analysis

STR analysis is the current gold standard in forensic DNA profiling. It examines multiple STR loci simultaneously (multiplexing), increasing discriminatory power.[12] International forensic systems, such as CODIS (Combined DNA Index System) in the United States, rely on standardized STR loci for database comparison.

Statistical Interpretation and Population Genetics

A critical scientific component of DNA profiling is statistical interpretation. DNA evidence is not presented merely as a match or non-match; instead, experts calculate the probability of a random match occurring within a population. This is based on principles of population genetics, particularly the Hardy–Weinberg equilibrium.[1141]The random match probability is determined by multiplying allele frequencies across independent loci. When multiple STR loci are analysed, the combined probability of coincidence becomes astronomically low, often in the range of one in several billion.[17] However, statistical interpretation requires accurate population databases and careful consideration of subpopulation effects. Inadequate statistical evaluation may undermine reliability.[1142]

Biological Sources of DNA Evidence DNA can be extracted from a variety of biological materials, including:

- Blood
- Semen
- Saliva
- Hair roots
- Bone and teeth and Skin cells (touch DNA)

The stability of DNA allows recovery even from degraded samples, although environmental factors such as heat, humidity, and microbial contamination may affect quality. Mitochondrial DNA (mtDNA), inherited maternally, is particularly useful when nuclear DNA is degraded. It is commonly used in cases involving old skeletal remains or missing persons.

Statistical Interpretation of DNA Evidence

The scientific basis of DNA profiling also involves statistical analysis. DNA evidence is not interpreted in absolute terms but in probabilities. Forensic experts calculate the likelihood that a DNA profile matches a particular individual compared to a random person from the population. This is expressed as the Random Match Probability (RMP) or likelihood ratio. The lower the probability of a random match, the stronger the evidentiary value.[1143] Population genetics plays a crucial role in this process, as allele frequencies vary among different populations. Databases are used to estimate these frequencies and calculate match probabilities.

STATUTORY FRAMEWORK OF DNA PROFILING:

Constitutional Framework and DNA Profiling as Evidence in India: The use of DNA profiling as evidence in India is deeply intertwined with constitutional principles, particularly those relating to personal liberty, privacy, dignity, and protection against self-incrimination. While DNA evidence has gained increasing acceptance due to its scientific reliability, its application must conform to the safeguards enshrined in the Constitution of India. The constitutional framework thus plays a crucial role in determining the limits within which DNA profiling may be used in forensic

[1141] William J. Ewens, *Mathematical Population Genetics* 23 (2d ed. 2004) [17] Butler, *Fundamentals of Forensic DNA Typing*, supra note 3, at 203.

[1142] David H. Kaye et al., *The New Wigmore: A Treatise on Evidence—Expert Evidence* 453 (2d ed. 2011).

[1143] Ian W. Evett & Bruce S. Weir, *Interpreting DNA Evidence* 102 (1998).

investigations and judicial proceedings. Article 21: Right to Life, Personal Liberty, and Privacy.

Article 21 of the Constitution guarantees the right to life and personal liberty, which has been expansively interpreted by the Supreme Court of India to include the right to privacy, dignity, and bodily integrity. DNA profiling involves the extraction and analysis of biological samples, which directly implicates these rights.

The landmark judgment in Justice K.S. Puttaswamy v. Union of India recognized the right to privacy as a fundamental right under Article 21. The Court held that informational privacy, including control over personal data, is an essential facet of individual autonomy. DNA data, being highly sensitive and capable of revealing intimate personal information, falls squarely within this protective ambit.[1144] Therefore, any collection, storage, or use of DNA samples must satisfy the threefold test laid down in *Puttaswamy*:

- Legality (existence of a valid law)
- Legitimate aim (state interest)
- Proportionality (least intrusive measure)

In the absence of a comprehensive DNA law, concerns arise regarding whether current practices meet these constitutional requirements.

2. Article 20(3): Protection Against Self-Incrimination

Article 20(3) provides that no person accused of an offence shall be compelled to be a witness against himself. A critical constitutional question is whether compulsory extraction of DNA samples violates this protection. In *State of Bombay v. Kathi Kalu Oghad*, the Court distinguished between **testimonial evidence** and **physical evidence**, holding that the latter does not fall within the scope of self-incrimination.[1145] The Court observed that giving fingerprints or specimen signatures does not amount to being a "witness" in the constitutional sense.

This principle has been extended to DNA profiling, as it involves the collection of physical evidence rather than testimonial compulsion. However, the degree of intrusion involved in DNA extraction is greater than traditional identification methods, raising concerns about bodily integrity. In Selvi v. State of Karnataka, the Court held that involuntary administration of techniques such as narcoanalysis and polygraph tests violates Article 20(3) and Article 21. While DNA profiling was not directly invalidated, the judgment emphasized the importance of consent and minimal intrusion, thereby influencing how DNA evidence is treated constitutionally. DNA profiling involves the extraction of bodily substances such as blood, saliva, or hair, raising issues of bodily integrity and consent. The Supreme Court has recognized that any intrusion into the human body must be justified by law and carried out in a fair, just, and reasonable manner.

In Selvi case, the Court emphasized that forcible extraction of information from the body must be carefully scrutinized to ensure it does not violate personal autonomy. Although DNA sampling is generally considered less intrusive than other techniques, it still requires adherence to procedural safeguards.

PROFILING UNDER THE INDIAN EVIDENCE ACT, 1872:

The Indian Evidence Act, 1872, though enacted in the nineteenth century, continues to govern the admissibility of modern scientific evidence, including DNA profiling, in Indian courts. While the Act does not expressly refer to DNA evidence, its flexible provisions—particularly those relating to relevancy, expert opinion, and presumptions—have enabled courts to incorporate DNA profiling within the evidentiary framework. The interaction between traditional evidentiary rules and advanced forensic science has led to significant judicial interpretation, shaping the admissibility,

[1144] Justice K.S. Puttaswamy v. Union of India, (2017) 10 S.C.C. 1, 248 (India)
[1145] State of Bombay v. Kathi Kalu Oghad, A.I.R. 1961 S.C. 1808, 16 (India

INDIAN JOURNAL OF LEGAL REVIEW [IJLR – IF SCORE – 7.58]
VOLUME 6 AND ISSUE 3 OF 2026
APIS – 3920 - 0001 *(and)* ISSN - 2583-2344
Published by
Institute of Legal Education
https://iledu.in

reliability, and evidentiary weight of DNA evidence

in India.

Relevancy of DNA Evidence (Sections 5–11):

Under the Evidence Act, only relevant facts are admissible. DNA evidence is generally introduced to establish identity, linkage, or biological relationships, making it highly relevant under Sections 5 and 9. Section 9, in particular, allows facts necessary to explain or introduce relevant facts, which includes identification evidence.

DNA profiling is often used to connect an accused to a crime scene or to establish paternity, thereby making it directly relevant to facts in issue. Courts have recognized that scientific evidence, when properly obtained, enhances the accuracy of fact-finding.[1146]

Expert Opinion (Section 45):

Section 45 of the Evidence Act is the most crucial provision governing DNA profiling. It provides that when the court has to form an opinion upon a point of science, the opinions of persons especially skilled in such science are relevant facts.

DNA analysts and forensic experts fall within the scope of "experts" under this provision. Courts rely on their testimony to interpret DNA results, explain methodologies, and provide statistical probabilities. However, expert opinion is not conclusive and must be evaluated along with other evidence.[23] The Supreme Court of India has consistently held that expert evidence is advisory in nature and must be corroborated where necessary.[1147] This ensures that courts do not rely blindly on scientific testimony without judicial scrutiny.

Presumption of Legitimacy and DNA Evidence (Section 112):

One of the most contentious issues in the application of DNA profiling arises under Section 112 of the Evidence Act, which presumes that a child born during the subsistence of a valid marriage is legitimate. This presumption is considered conclusive unless non-access between the spouses is proved. However, DNA profiling can scientifically determine paternity with near certainty, leading to a conflict between legal presumption and scientific evidence.

In *Goutam Kundu v. State of West Bengal*, the Court held that DNA tests should not be ordered routinely and emphasized the importance of protecting family stability.[1148]

Subsequently, in *Banarsi Dass v. Teeku Dutta*, the Court reiterated that DNA evidence should not be used to displace the presumption under Section 112 lightly.[1149] However, a shift occurred in *Nandlal Wasudeo Badwaik v. Lata Nandlal Badwaik*, where the Court gave primacy to scientific evidence, holding that DNA results must prevail when they are clear and conclusive.[1150] This marked a significant development in reconciling statutory presumptions with modern science.

Burden of Proof and DNA Evidence (Sections 101–106):

The provisions relating to burden of proof are also relevant in the context of DNA profiling. Sections 101–103 place the burden on the party asserting a fact. DNA evidence can be used to discharge this burden by providing strong scientific proof. Section 106, which deals with facts especially within the knowledge of a person, has been invoked in cases where refusal to undergo DNA testing may lead to adverse inference. Courts have held that while individuals cannot be forcibly compelled in all circumstances, refusal without justification may weaken their case.[28] Admissibility vs. Probative Value: The Evidence Act distinguishes between admissibility and weight of evidence. DNA

[1146] Ratanlal & Dhirajlal, *The Law of Evidence* 112 (26th ed. 2017) [23] State of H.P. v. Jai Lal, (1999) 7 S.C.C. 280, ¶ 17 (India).
[1147] Avtar Singh, *Principles of the Law of Evidence* 523 (24th ed. 2016).
[1148] Goutam Kundu v. State of W.B., (1993) 3 S.C.C. 418, ¶ 26 (India).
[1149] Banarsi Dass v. Teeku Dutta, (2005) 4 S.C.C. 449, ¶ 13 (India).
[1150] Nandlal Wasudeo Badwaik v. Lata Nandlal Badwaik, (2014) 2 S.C.C. 576, 17 (India) [28] Sharda v. Dharmpal, (2003) 4 S.C.C. 493, ¶ 79 (India).

evidence, once admitted under Section 45, must still be evaluated for its probative value. Factors affecting its weight include:

- Proper collection and preservation of samples
- Absence of contamination
- Accuracy of laboratory analysis
- Credibility of expert testimony

Courts have emphasized that DNA evidence, though highly reliable, is not infallible and must be assessed in the context of the entire evidence on record.[1151]

DNA TECHNOLOGY (USE AND APPLICATION) REGULATION BILL IN INDIA AND ITS ROLE IN FORENSIC SCIENCE :

The DNA Technology (Use and Application) Regulation Bill represents a significant legislative effort by the Indian government to establish a comprehensive legal framework governing the use of DNA profiling in forensic science and related fields. Recognizing the increasing reliance on DNA evidence in criminal investigations, civil disputes, and identification processes, the Bill seeks to regulate the collection, storage, analysis, and use of DNA data in a structured and legally accountable manner. It aims to bridge the gap between rapid scientific advancements and the absence of specific statutory provisions, thereby enhancing the credibility and efficiency of forensic investigation in India.

At its core, the Bill proposes the establishment of a **DNA Regulatory Board**, which would function as the central authority responsible for supervising DNA laboratories, setting quality standards, and ensuring compliance with prescribed procedures. The Board is tasked with accrediting laboratories, formulating guidelines for DNA profiling, and overseeing training and capacity-building in forensic science. This institutional mechanism is crucial for maintaining uniformity and scientific integrity in DNA analysis across the country, as inconsistencies in laboratory practices have historically raised concerns regarding the reliability of forensic evidence. A key feature of the Bill is the creation of **National and Regional DNA Data Banks**, which are intended to store DNA profiles for specified purposes. These databanks would include indices such as crime scene index, suspects' index, offenders' index, missing persons' index, and unknown deceased persons' index. The objective is to facilitate efficient comparison and matching of DNA profiles, thereby aiding in criminal investigations, identification of victims, and resolution of missing persons cases. By enabling systematic data storage and retrieval, the Bill seeks to significantly improve the speed and accuracy of forensic processes.

The Bill also delineates the **permissible uses of DNA profiling**, restricting it to specific purposes such as criminal investigations, civil disputes (including paternity and maternity cases), identification of human remains, and disaster victim identification. It explicitly prohibits the use of DNA data for purposes beyond those authorized, thereby attempting to prevent misuse. However, the scope of permissible use remains broad, raising concerns about potential overreach and function creep in the absence of stringent safeguards.

In terms of procedural safeguards, the Bill lays down provisions for the **collection of biological samples**, emphasizing the need for consent in certain cases and legal authorization in others. It distinguishes between different categories of individuals, such as suspects, undertrials, victims, and volunteers, and prescribes varying standards for sample collection. The Bill also mandates the removal of DNA profiles from databanks in specified circumstances, such as acquittal or discharge, thereby recognizing the importance of protecting individual rights.

Despite these safeguards, the Bill has attracted criticism on constitutional

[1151] State of Bombay v. Kathi Kalu Oghad, A.I.R. 1961 S.C. 1808 (India).

and ethical grounds. One of the primary concerns relates to the **right to privacy**, as recognized in Justice K.S. Puttaswamy v. Union of India. DNA data contains highly sensitive personal information, including genetic traits and familial relationships, making it susceptible to misuse if not adequately protected. Critics argue that the Bill lacks robust data protection mechanisms, clear limitations on data retention, and independent oversight, thereby posing risks of surveillance and unauthorized access.

Another concern is the potential conflict with the principle against self-incrimination under Article 20(3) of the Constitution. While DNA profiling is generally categorized as physical evidence, the compulsory extraction and storage of genetic material may still raise questions about bodily autonomy and coercion. The Bill attempts to address these concerns by prescribing procedural safeguards, but the adequacy of these measures remains a subject of debate.

From a forensic perspective, the Bill is expected to significantly enhance the **scientific reliability and evidentiary value of DNA profiling**. By standardizing laboratory procedures, ensuring accreditation, and maintaining centralized databases, it addresses many of the practical challenges currently faced in forensic investigations, such as contamination, lack of uniform standards, and delays in analysis. It also facilitates better coordination between investigative agencies and forensic institutions, thereby strengthening the overall criminal justice system.

However, the effectiveness of the Bill will depend on its implementation and the establishment of adequate infrastructure. India currently faces limitations in terms of forensic laboratories, trained personnel, and technological resources. Without addressing these issues, the benefits of the Bill may not be fully realized. Additionally, the absence of a comprehensive data protection law further complicates the regulatory landscape, as DNA data requires the highest level of confidentiality and security.

1.Constitutional validity and the doctrine of self-inscrimination

A landmark constitutional development occurred in *Selvi v. State of Karnataka*, where the Supreme Court examined the permissibility of scientific techniques in criminal investigations.[27] The Court distinguished between **testimonial compulsion** and **physical evidence**, holding that the collection of bodily substances such as blood for DNA analysis does not violate Article 20(3) of the Constitution. This principle is rooted in the earlier judgment of *State of Bombay v. Kathi Kalu Oghad*, where the Court held that giving fingerprints or handwriting samples does not amount to self-incrimination.[1152] DNA profiling, being physical evidence, falls within this permissible category.

However, the Court in *Selvi* also emphasized that involuntary extraction of evidence must comply with Article 21, ensuring fairness, dignity, and due process. Thus, while DNA profiling is constitutionally valid, it must adhere to procedural safeguards.

2. Recognition of DNA Evidence in Criminal Jurisprudence

The judiciary has increasingly recognized DNA profiling as a highly reliable form of evidence in criminal trials. In *Krishan Kumar Malik v. State of Haryana*, the Supreme Court underscored the importance of DNA testing in rape cases, stating that failure to conduct such tests may weaken the prosecution's case.[35]

Similarly, in *Mukesh v. State (NCT of Delhi)* (Nirbhaya case), DNA evidence was crucial in linking the accused to the crime.[36] The Court relied heavily on DNA reports to corroborate medical findings and eyewitness testimony, thereby affirming its evidentiary significance.

[1152] *State of Bombay v. Kathi Kalu Oghad*, AIR 1961 SC 1808 (India). [35] *Krishan Kumar Malik v. State of Haryana*, (2011) 7 SCC 130 (India) [36] *Mukesh v. State (NCT of Delhi)*, (2017) 6 SCC 1 (India).

INDIAN JOURNAL OF LEGAL REVIEW [IJLR – IF SCORE – 7.58]
VOLUME 6 AND ISSUE 3 OF 2026
APIS – 3920 - 0001 *(and)* ISSN - 2583-2344
Published by
Institute of Legal Education
https://iledu.in

In *State of Himachal Pradesh v. Rajesh Kumar*, the Court observed that DNA profiling is an extremely accurate and scientifically advanced method for establishing identity and guilt.[1153] These cases collectively demonstrate the judiciary's growing reliance on DNA evidence in serious criminal offences.

3. Evidentiary Value under the Indian Evidence Act, 1872:

DNA evidence is generally admitted as **expert evidence** under Sections 45 and 46 of the Indian Evidence Act, 1872. Courts have clarified that DNA reports must be supported by expert testimony and proper documentation. In *Irfan @ Bhayu Mevati v. State of Madhya Pradesh*, the Supreme Court held that the evidentiary value of DNA reports depends on proper proof, including examination of the expert and maintenance of the chain of custody.[1154] Similarly, in *Anil v. State of Maharashtra*, the Court emphasized that DNA evidence must be handled with strict procedural compliance to ensure its admissibility.[1155] Thus, while DNA evidence is scientifically robust, its legal admissibility depends on adherence to evidentiary rules .

4. DNA Evidence in Paternity and Civil Disputes:

In civil cases, particularly those involving paternity, courts have adopted a cautious approach. In *Nandlal Wasudeo Badwaik v. Lata Nandlal Badwaik*, the Supreme Court gave primacy to DNA evidence over presumptions under Section 112 of the Evidence Act, holding that scientific truth must prevail over legal fiction.[1156] However, in *Ashok Kumar v. Raj Gupta*, the Court reiterated that DNA testing should not be ordered routinely and must be justified by compelling circumstances.[41] These cases illustrate the judiciary's effort to balance scientific accuracy with social and legal considerations.

5. Limitations: DNA Evidence Not Always Conclusive:

Despite its reliability, courts have consistently held that DNA evidence is not infallible. In *Santosh Kumar Singh v. State through CBI* (Priyadarshini Mattoo case), DNA evidence was considered alongside other circumstantial evidence to establish guilt.[1157]

In *Neelu @ Nilesh Koshti v. State of Madhya Pradesh*, the Court held that absence of DNA evidence does not necessarily invalidate a conviction if other evidence is sufficient.[1158]

This indicates that DNA evidence is corroborative rather than conclusive and must be evaluated in the context of the entire evidentiary framework.

6. Procedural Safeguards and Chain of Custody:

Courts have emphasized that the reliability of DNA evidence depends on proper collection, preservation, and analysis. In *Rahul v. State (NCT of Delhi)*, the Supreme Court refused to rely on DNA evidence due to gaps in the chain of custody.[44]

Similarly, in *Sunil v. State of Madhya Pradesh*, the Court highlighted the importance of maintaining proper forensic procedures to avoid contamination and tampering.[45]

These cases underscore that procedural lapses can undermine even the most reliable scientific evidence.

7. Privacy and Fundamental Rights:

The recognition of privacy as a fundamental right in *K.S. Puttaswamy v. Union of India* has significant implications for DNA profiling.[1159] Courts have since emphasized that DNA testing must satisfy the principles of legality, necessity, and proportionality.

8. Emerging Judicial Trends:

[1153] *State of H.P. v. Rajesh Kumar*, (2018) 2 SCC 69 (India)
[1154] *Irfan @ Bhayu Mevati v. State of M.P.*, (2017) 16 SCC 765 (India).
[1155] *Anil v. State of Maharashtra*, (2014) 4 SCC 69 (India).
[1156] *Nandlal Wasudeo Badwaik v. Lata Nandlal Badwaik*, (2014) 2 SCC 576 (India). [41] *Ashok Kumar v. Raj Gupta*, (2022) 1 SCC 20 (India).
[1157] *Santosh Kumar Singh v. State (CBI)*, (2010) 9 SCC 747 (India).
[1158] *Neelu @ Nilesh Koshti v. State of M.P.*, (2026) SCC OnLine [44] *Rahul v. State (NCT of Delhi)*, (2023) SCC OnLine SC [45] *Sunil v. State of M.P.*, (2017) 4 SCC 393 (India).
[1159] *K.S. Puttaswamy v. Union of India*, (2017) 10 SCC 1 (India).

INDIAN JOURNAL OF LEGAL REVIEW [IJLR – IF SCORE – 7.58]
VOLUME 6 AND ISSUE 3 OF 2026
APIS – 3920 - 0001 *(and)* ISSN - 2583-2344
Published by
Institute of Legal Education
https://iledu.in

Recent judicial trends indicate a more structured approach toward DNA evidence:

- Greater reliance on DNA profiling in criminal investigations
- Increased emphasis on procedural safeguards
- Recognition of privacy and data protection concerns
- Judicial insistence on corroborative evidence

The judiciary continues to play a vital role in shaping the legal framework governing DNA profiling in India.

DNA FINGERPRINTING'S RELIABILITY IN OTHER COUNTRIES:

The reliability of DNA fingerprinting in forensic science varies across countries depending on the strength of scientific infrastructure, legal safeguards, database systems, and judicial standards. While the core scientific principles of DNA profiling remain universally consistent, its forensic reliability is significantly influenced by how effectively each country regulates, interprets, and applies the technology. A comparative analysis between India and countries such as the United States, the United Kingdom, and other developed jurisdictions highlights both strengths and limitations in the Indian context.

In the United States, DNA evidence is considered highly reliable due to stringent admissibility standards and advanced forensic infrastructure. Courts follow the Daubert standard, established in *Daubert v. Merrell Dow Pharmaceuticals*, which requires that scientific evidence be tested, peer-reviewed, and widely accepted in the scientific community. DNA profiling in the U.S. is supported by the Combined DNA Index System (CODIS), a comprehensive national database that enhances the accuracy and efficiency of criminal investigations. Additionally, accreditation bodies and strict laboratory protocols ensure minimal error rates. As a result, DNA evidence in the U.S. is often regarded as the "gold standard" in forensic identification, with courts placing high evidentiary value on properly collected and analyzed DNA samples.

Similarly, in the United Kingdom, DNA profiling is highly reliable due to well-developed institutional frameworks and regulatory oversight. The UK established the National DNA Database, one of the largest and most sophisticated DNA databases in the world. The reliability of DNA evidence is further reinforced by adherence to scientific standards set by the Forensic

Science Regulator and the application of rigorous chain-of-custody procedures. Courts in the UK generally accept DNA evidence as conclusive when supported by statistical probability and proper expert testimony. However, judicial caution is exercised in cases involving mixed DNA samples or contamination risks, reflecting a balanced approach between scientific reliance and legal scrutiny.

In contrast, India has made significant progress in adopting DNA fingerprinting, but challenges remain in ensuring its consistent reliability. Indian courts have recognized DNA evidence as a powerful investigative tool, particularly in cases such as *State of Bombay v. Kathi Kalu Oghad* and *Selvi v. State of Karnataka*, where the admissibility of scientific techniques was discussed in the context of constitutional protections. However, unlike the U.S. or UK, India lacks a fully operational and uniformly regulated national DNA database, although legislative efforts such as the DNA Technology (Use and Application) Regulation Bill have aimed to address this gap.

One of the major concerns affecting reliability in India is the lack of standardized forensic infrastructure and trained personnel. Many forensic laboratories face issues such as backlog of cases, inadequate funding, and limited access to advanced technology. These factors can lead to delays and, in some cases, compromise the

quality of DNA analysis. Studies have also pointed out that developing countries, including India, often face barriers such as limited access to independent defense experts, which may reduce the ability to challenge forensic evidence effectively.

Another significant issue in India is the absence of uniform guidelines for collection, preservation, and analysis of DNA samples. While provisions under the Criminal Procedure Code and judicial precedents allow for DNA testing, procedural inconsistencies can affect evidentiary reliability. Contamination, improper handling, and lack of chain-of-custody documentation can weaken the probative value of DNA evidence in court. In contrast, countries like the U.S. and UK have well-defined protocols that ensure scientific integrity at every stage.

Furthermore, judicial interpretation plays a crucial role in determining the reliability of DNA evidence. In developed jurisdictions, courts often rely on expert testimony supported by statistical analysis, such as random match probability, to assess reliability. Indian courts, while increasingly receptive to DNA evidence, sometimes lack detailed engagement with the underlying scientific methodology, leading to inconsistent standards of evaluation. This creates uncertainty regarding the weight to be assigned to DNA evidence in different cases.

Privacy and ethical concerns also impact the reliability and acceptability of DNA profiling across jurisdictions. In the U.S. and UK, robust data protection laws regulate the storage and use of genetic information. In India, however, concerns remain regarding data protection, misuse of genetic information, and lack of comprehensive privacy safeguards, especially in the absence of a fully implemented regulatory framework. These issues can undermine public trust and indirectly affect the perceived reliability of DNA evidence.

Despite these challenges, it is important to note that the scientific reliability of DNA profiling itself is not inherently weaker in India. The underlying technology—based on principles such as Short Tandem Repeat (STR) analysis—is universally accepted and scientifically robust. The differences arise primarily from institutional, procedural, and legal factors, rather than the science itself. With ongoing reforms, including proposed legislation and improvements in forensic infrastructure, India is gradually moving towards aligning its standards with international best practices.

SUGGESTIONS:

1.**Enact a Comprehensive DNA Law**
India should enact and effectively implement legislation such as the **DNA Technology (Use and Application) Regulation Bill** to regulate collection, storage, and use of DNA data while ensuring protection of privacy and fundamental rights.

2. **Strengthen Forensic Infrastructure**
The government should expand and modernize forensic laboratories such as the **Centre for DNA Fingerprinting and Diagnostics** and **Central Forensic Science Laboratory**, provide advanced technology, and train forensic experts to reduce delays and improve accuracy.

3.**Ensure Strong Data Protection and Ethical Safeguards**
Clear guidelines should be introduced for consent, storage, and use of genetic information to prevent misuse and protect individual privacy, especially in light of constitutional protections recognized in **Justice K. S. Puttaswamy v. Union of India**.

CONCLUSION:

DNA fingerprinting has emerged as one of the most significant scientific advancements in forensic science, offering an exceptionally high degree of accuracy in the identification of individuals. Its application in criminal investigations has transformed the evidentiary landscape by

providing objective, reliable, and scientifically validated proof, thereby reducing dependence on less reliable forms of evidence such as eyewitness testimony and confessions. In India, the growing acceptance of DNA profiling by courts reflects an increasing recognition of its value in ensuring justice and enhancing the efficiency of the criminal justice system.

However, the study demonstrates that the reliability and admissibility of DNA evidence in India are not determined solely by its scientific credibility. Instead, they are deeply influenced by legal standards, procedural compliance, and constitutional safeguards. The role of the Supreme Court of India has been pivotal in shaping the jurisprudence surrounding DNA evidence, as it has consistently emphasized a balanced approach—recognizing the probative value of DNA profiling while safeguarding fundamental rights such as privacy, dignity, and protection against self-incrimination.

The analysis further reveals that although DNA profiling is scientifically robust, its practical reliability in India is often affected by challenges such as inadequate forensic infrastructure, lack of standardized procedures, risks of contamination, and delays in laboratory analysis. The absence of a comprehensive and fully implemented statutory framework, particularly in relation to the DNA Technology (Use and Application) Regulation Bill, contributes to inconsistencies in the application and regulation of DNA evidence. Additionally, concerns relating to data protection and ethical use of genetic information highlight the need for stronger legal safeguards.

REFERENCE:

1. John M. Butler, Forensic DNA Typing: Biology, Technology and Genetics of STR Markers, Elsevier Science & Technology Books, 2005.

2. Pankaj Shrivastava, Hirak Ranjan Dash, José A. Lorente & Jahangir Imam (eds.), Forensic DNA Typing: Principles, Applications and Advancements, Springer Nature Singapore, 2020.

3. M. Krawczak & J. Schmidtke, DNA Fingerprinting, Taylor & Francis / Routledge, 1998.

4.