Comparative Analysis of DNA Profiling in India and USA

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Introduction:

Advancements in scientific technology have brought about revolutionary changes in people's lives. While these changes have positively impacted lifestyles and amenities, they have also presented a challenge for law enforcement agencies in preventing technology misuse by criminals for illegal activities. Scientific examination of evidence yields significant scientific proof, and this application of science to criminal investigations is known as Forensic Science. These technological advancements have frequently had a substantial impact on the administration of justice, but when employed judiciously, they can greatly transform the criminal justice system.

Forensic science has evolved into a powerful tool for the judiciary and law enforcement agencies. Forensic scientists and criminal investigators have always strived to accurately determine the source of biological evidence found at crime scenes. Forensic science has not

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only developed its own techniques but also established specialised fields within it, such as the study of fingerprints, anthropometry, track marks, documents, and forensic ballistics. DNA technology represents the latest advancement in forensic science, stemming from remarkable progress in genetic science.

DNA profiling enables the analysis of human biological material at the fundamental level of the DNA molecule, which exists in every living cell within the biological system and contains the unique genetic information that distinguishes one individual from another. DNA from biological samples like semen, blood, or tissue is extracted and examined during the DNA profiling process. DNA profiling is notable for its remarkably low likelihood of producing false positives. As long as rigorous laboratory standards are rigorously adhered to, DNA profiling evidence should be considered as credible as any other form of scientific evidence presented in a court of law. Additionally, DNA profiling represents a significant advancement in science's ability to determine whether two body samples collected at different times originate from the same person. Thus, this paper shall discuss the use and application of DNA Profiling, the admissibility of such evidence in Indian Courts and further analyse the position of laws relating to DNA profiling In India and USA through the help of judicial pronouncements.

DNA Profiling and its Application:

- DNA Profiling

DNA fingerprinting, also known as DNA profiling, is a forensic method used for identifying individuals by examining the distinct patterns present within their DNA. While 99.9% of human DNA is shared among individuals, the remaining 0.1% contains unique genetic markers, rendering each person's DNA unique, except for identical twins, who share the same genetic code.[1] These differences arise due to genetic mutations that have occurred during the process of evolution. DNA fingerprinting involves a meticulous analysis of the human genetic blueprint, offering multifaceted advantages in the realm of criminal investigations.[2]

In practical terms, DNA profiling entails chemically dividing DNA into fragments that form a distinct pattern. This pattern is then compared to the 'identity profile' derived from testing a suspect's blood sample. When these two patterns match, the likelihood of error, i.e., the probability that they do not belong to the same individual, becomes exceedingly low, sometimes as low as one in 30 billion. DNA profiling represents a crucial biological tool enabling scientists to compare DNA material samples. Forensic scientists employ DNA profiling to aid in identifying individuals through their unique DNA profiles. As previously mentioned, with the exception of identical twins, the DNA

[1]Dr. V Nageswara Rao, The Indian Evidence Act, A Critical Commentary Covering Emerging Issues and International Development (2nd edn, LexisNexis 2015) 462; Mary May, 'Next Generation Forensics: Changing the Role DNA Plays in the Justice System' (Science in the News November 9, 2018) accessed 24 January 2021

[2] Dr Tabasum Ara , *DNA Profiling in Criminal Justice System of India: Relevance and Importance*, IJRTI, (12th October, 2023, 6:30 pm), https://www.ijrti.org/papers/IJRTI2208020.pdf

of every individual is distinct and exclusive, making DNA profiling an invaluable tool in investigative procedures.[3]

DNA analysis unveils the genetic profile of an individual, and when compared to samples gathered from a crime scene or, in cases of establishing paternity, with the samples of other individuals, it provides definitive proof of a connection or relationship. This method represents a form of justice through advanced science.[4] DNA profiling has gained support for various reasons. It serves as a potent identification tool in cases where reliable eyewitness identification is unavailable. It can distinguish serial crimes from "copy-cat" crimes or link unsolved crimes. It saves time and resources for the courts, preventing unnecessary distress for both victims and suspects by (a) excluding innocent suspects, (b) eliminating trials based on DNA evidence leading to confessions, and (c) focusing defense arguments in cases that do proceed to trial, such as consent or alibi defenses.

- Application of DNA Profiling and its use:

DNA profiling serves as a potent and highly precise forensic tool employed by law enforcement agencies worldwide in numerous cases each year. Its utility extends to post-mortem examinations where the

[3] Anusha Jain, "DNA technology and its Impact on Law", Nalsar Law Review, vol.3 2006-2007

[4] Dr. V Nageswara Rao, The Indian Evidence Act, A Critical Commentary Covering Emerging Issues and International Development (2nd edn, LexisNexis 2015) 462; Mary May, 'Next Generation Forensics: Changing the Role DNA Plays in the Justice System' (Science in the News November 9, 2018) accessed 24 January 2021.

identification of deceased individuals presents challenges, such as in instances of incineration, drowning, or significant decomposition of a body. In situations where conventional methods like radiography and odontology prove inadequate, DNA profiling becomes invaluable. It particularly shines when dealing with investigations into incidents where multiple individuals have been harmed or killed. By pinpointing the probable origin of a bloodstain at a crime scene, investigative teams can deduce the positioning of individuals during the commission of the crime and retrace their movements within the crime scene. Furthermore, DNA profiling plays a crucial role in police investigations involving crimes like prolonged abuse, offering a positive means of identifying the source of even minute bloodstains dispersed at the scene, confirming them as belonging to the victims.[5]

One of the most remarkable attributes of DNA profiling is its capacity to resolve cold cases. Thanks to DNA technology, samples from historical unsolved crimes can be reexamined, potentially leading to the apprehension of suspects many years after the crime was committed. With its power to either implicate or exonerate individuals, DNA profiling equips investigators with a formidable tool for unraveling criminal cases. Consequently, it becomes an essential addition to the conventional investigative techniques available.[6]

[5] B.R.Sharma, "Forensic Science in Criminal Investigation & Trials", 15 ed, New Delhi: Universal Law Publishing, p 3, 2016
[6] Justice R.K. Abhichandani, "New Biology & Criminal Investigation", pg 4, 2004.

DNA profiling enables the scrutiny of linked criminal strategies and the identification of emerging criminal trends, ultimately resulting in more efficient police management and corresponding savings in human, material, and financial resources. This technology can generate DNA profiles from a wide range of biological materials, including blood, tissue, bone, semen, skin, urine, bone marrow, feces, and cells found in saliva, sweat, and tears. The enhanced sensitivity of DNA technology means that profiles can now be obtained from contact traces, even after minimal contact between a person and an object. Examples of contact traces encompass fingerprints, ear-prints, facial contact smudges, saliva on beverage containers, material expelled through coughing and sneezing. The potential for recovering DNA trace evidence should be considered in all criminal investigations. In cases involving missing individuals, mass disasters, or unidentified bodies, DNA offers the opportunity for body identification.[7]

Methods of DNA Profiling:

The advent of DNA profiling in the realm of forensic science and law represents a significant advancement akin to fingerprinting. It asserts that challenging this technology is akin to disputing a fundamental scientific principle, akin to questioning the law of gravity. DNA testing, DNA profiling, and genetic fingerprinting are techniques employed to distinguish between individuals of the same species,

[7] Modi, "Medical Jurisprudence and Toxicology", 22 ed, LexisNexis Butterworths, p 65, 2001

solely through the analysis of DNA samples. Among the most common methods of DNA profiling are RFLP (Restriction Fragment Length Polymorphism) and PCR (Polymerase Chain Reaction).

In RFLP, DNA can be extracted from various sources, including blood, semen, hair, saliva, urine, and buccal swabs (inside the cheek). The DNA is extracted, and a restriction enzyme is introduced to break it into fragments. These fragments are separated into bands, resembling barcodes, during electrophoresis in an agarose gel. The band pattern is then transferred onto a nylon sheet. Radioactive probes adhere to the DNA fragments, identifying their sequences. When the nylon sheet is placed against the x-ray film, black bands appear where the probes have adhered to the fragments.[8]

On the other hand, the PCR method targets specific genetic information within a cell and amplifies it by a billion times for analysis. Synthetic DNA primers are created to seek out matching patterns within the separated DNA. A DNA polymerase is added, which prompts the DNA to create an exact copy of itself. The matter is heated to separate the strands once more, resulting in more copies. Approximately 30 cycles can generate a billion copies. This process typically takes about three

[8] S. Panneerchelvam and M.N. Norazmi, *Forensic DNA Profiling and Database*, NCBI, (14th October, 2023, 8:30 pm), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3561883/

hours. PCR is advantageous for its ability to analyse very small samples, but RFLP is often considered more precise.[9]

The widespread acceptance of this technology globally can be attributed to various factors, including a strong focus on combating crime, which leaves the courts with little choice but to accept this invaluable scientific evidence with minimal scrutiny and substantial evidential reliability. In the context of "Relevancy," it is crucial to distinguish it from "admissibility" and "reliability." When new techniques, approaches, or assumptions are introduced in court, the Rules of Evidence come into play, and careful consideration is given to reliability, scientific recognition, and potential hazards long before a judge makes a decision.

The admissibility and relevance of DNA evidence have been subjects of extensive debate for decades. Traditionally, the cornerstone for admitting scientific evidence was the landmark case of Frye v. United States. [10] This case established the "general acceptance" standard, where scientific evidence's admissibility hinged on its acceptance within the relevant field. However, this changed in 1993 when the conflict between the "general acceptance standard" and the Federal Rules of Evidence was resolved in Daubert v. Merrell Dow

[9] Ankit Anand, *DNA PROFILING: A COMPARATIVE STUDY WITH REFERENCE TO INDIA, U.S.A. AND U.K*, JCIL l SYNDICATE, (13th October, 2023, 7:45 pm), https://jcil.lsyndicate.com/wp-content/uploads/2023/06/06.-DNA-PROFILING-A-COMPARATIVE-STUDY-WITH-REFERENCE-TO-INDIA-U.S.A.-AND-U.K.pdf

[10] 293 F, 1013 (1923)

Pharmaceuticals, Inc.[11] The court's decision indicated that judges should act as "gatekeepers," ensuring that any scientific evidence admitted is not only relevant to the matter at hand but also reliable.

In criminal cases, the interpretation of results obtained from DNA samples is paramount for a correct understanding of their implications. The results are contingent on how they are expressed, which, in turn, depends on the questions asked. Asking the wrong question can mislead the judge, leading to what is referred to as the "Prosecutor's Legacy" or "Prosecutor's Fallacy." This issue gained significant attention in the case of R v. Doheny and Adams[12], where the courts realised that heavy reliance on DNA samples as evidence could introduce potential taint or bias.

Position of India in regards to DNA Profiling and its Admissibility in Courts:

The Indian Constitution, serving as the foundational legal document of India, stands as a guardian of citizens' fundamental rights as delineated in Part III, securing their human rights and essential freedoms. Notably, Article 20(3) within the Constitution establishes a safeguard against self-incrimination, epitomising the principle of protection against compelled testimony detrimental to one's own interests. Furthermore, Article 21 sets a precedent against unwarranted encroachments into personal life and liberty. In light of these constitutional provisions, the

[11] 509 U.S. 579 (1993)
[12] (1997) 1 Cr App R 369

application of DNA profiling technology must conform to the standards outlined in Article 20(3) and Article 21, in addition to the principles established under the Maneka Gandhi case[13].

The legal framework for DNA profiling of individuals involved in criminal investigations is articulated in the Code of Criminal Procedure (CrPC). Sections 53 and 53-A of the CrPC delineate the procedures for DNA profiling. Section 53(1) authorises DNA profiling of the accused upon the police's request, while Section 53A focuses on DNA profiling in cases of alleged rape.[14] Importantly, these provisions do not infringe upon the Constitutional prohibition set forth in Article 20(3) since they do not involve coercive self-incrimination.[15]

The Indian Evidence Act of 1872, encompassing sections 45-51, addresses the admissibility of expert opinions as relevant facts in court proceedings. An expert, defined as an individual possessing specialised knowledge or skills derived from education, training, or experience, plays a critical role in this context. The expert opinion rule establishes a unique legislative framework within evidentiary jurisprudence. Notably, the personal opinions or beliefs of these experts hold no relevance. This legal exception is grounded in the doctrine of necessity, as it applies to questions extending beyond common knowledge and necessitating specialised expertise. Thus, in cases where scientific applications like DNA testing are essential and unattainable through

[13] (1987) 1 SCC 248: AIR 1987 SC 597
[14] Section 53A(1) & (2), Code of Criminal Procedure1973
[15] Anil A. Lokhande v. State of Maharashtra, 1981 Cri LJ 125, 130 (Bom)

common knowledge or experience, the courts rely on expert opinions to arrive at sound judgments.

In the Indian legal landscape, a specific law dedicated to DNA evidence remains absent. However, DNA testing has held legal validity since 1989. The case of Kunhiraman v. Manoj[16] marked a pivotal moment, as it involved a paternity dispute necessitating the introduction of DNA evidence in court proceedings. The court considered DNA evidence on par with the opinions of various experts, including forensic, ballistic, biological, and chemical experts. Furthermore, both the Indian government and the Law Commission have recognized the importance of DNA testing. The Indian Parliamentary Affairs Committee has even established an advisory committee to deliver comprehensive reports on various aspects of DNA testing. In its 185th report, the Law Commission recommended amending Article 112 of the Indian Evidence Act to incorporate DNA testing. This recommendation led to the passage of the Criminal Procedure Act (Amendment) Act 2005, emphasizing the government's increasing consideration of DNA analysis and its reliability. Notably, Section 53(2) was amended to facilitate the examination of the defendant's blood, semen, saliva, and more by a doctor or medical practitioner upon a police officer's request in connection with a medical examination of the accused.[17]

[16] II (1991) DMC 499
[17] *Supra* 9

In the case of Kantidev vs Poshiram[18], which involved a paternity dispute, the court explicitly affirmed the scientific accuracy of a genuine DNA test. However, the court emphasized that even the scientific validity of a DNA test does not provide a legal escape from the conclusiveness of Section 112 of the Indian Evidence Act. For example, if a husband and wife were cohabiting during the time of conception, but a DNA test indicates that the child is not biologically related to the husband, the legal presumption of paternity remains irrebuttable. While this may seem harsh for the husband, who is compelled to acknowledge fatherhood of a child not biologically his own, the law's inclination favours protecting the rights of the innocent child, particularly if the mother and her spouse were living together during the time of conception. Therefore, the determination of the degree of proof required to challenge the presumption under Section 112 must be made in consideration of what constitutes access or non-access, as explained above.

This judgment laid the foundation for the decision in another paternity case, Nandlal Wasudeo Badwaik vs Lata Nandlal Badwaik[19]. In this case, the husband sought a DNA test to establish the paternity of his child. The DNA analysis excluded the husband as the biological father. The wife invoked Section 112 of the Indian Evidence Act, as established in the Kantidev vs Poshiram[20] case. The court held that, depending on the specific facts and circumstances of each case, it may

[18] 2001 (5) SCC311
[19] AIR 2014 SC 932
[20] 2001 (5) SCC311

be permissible for the court to order a DNA examination to verify the allegations presented. However, such an order should be issued sparingly, as the legitimacy of the child should not be needlessly jeopardised.

In the case of Narendra G. Goel vs State of Maharashtra and Another[21], the Hon'ble Supreme Court of India acknowledged the admissibility of mitochondrial DNA testing as evidence for identifying a deceased woman and determining the culpability of the accused. This recognition was made without any adverse impact on the rights of the accused. In this context, the Court concluded that a comprehensive report encompassing all materials collected during the investigation in India, including the mitochondrial DNA test report conducted by the Office of the Chief Coroner of Ontario, is admissible for review. The decision regarding the presentation of this evidence will be made by the Indian courts. The probative value of the evidence presented by the prosecution can be examined during the trial proceedings, and the defendant is not entitled to make a statement during the pre-trial phase of the investigation.

[21] (2009) 6 SCC

DNA Profiling in USA and its Admissibility:

In the United States, two primary tests are applied to assess the admissibility of scientific information presented by experts. One of these is the Frye test, as articulated in Frye v. United States. The other is the "helpfulness" standard found in the Federal Rules of Evidence and in many state legal systems.

The Frye Test:

The Frye Standard is employed to determine the admissibility of an expert's scientific testimony and other forms of evidence, as initially established in Frye v. United States[22]. This standard was introduced to restrict the introduction of evidence and expert testimony to materials that could be considered reliable, as determined by the consensus within the relevant field. It ensures that new methodologies gain broad recognition before being utilized. When the Frye Standard is applied to physical evidence, the court must assess whether the method employed to obtain that evidence is widely accepted by experts within the specific field to which it pertains. In the context of expert testimony, the court, following the Frye Standard, must determine whether the methodologies employed by the expert align with the generally accepted practices of specialists in that particular field.

The Frye Standard has been abandoned by many states and federal courts in favor of the Daubert Standard. Nonetheless, it remains in

[22] (293 F. 1013, D.C. Cir. 1923)

force in certain jurisdictions. The Frye Standard faced criticism for potentially hindering the use of reliable technology in court simply because it had not yet gained acceptance within a particular field. In contrast, the Daubert Standard, embraced by the Supreme Court, expands the criteria considered, encompassing factors such as whether the methodology has undergone testing, peer review, demonstrated reliability, and adherence to established usage standards. This broader set of considerations may lead to the acceptance of a novel methodology into evidence, even if it exhibits a high level of reliability but has not yet gained widespread adoption due to its novelty. For example, the extensive use of fingerprints initially encountered challenges due to the techniques and resources required for fingerprint analysis.[23] However, fingerprints have proven to be highly reliable evidence, making them eligible for acceptance under the Daubert Standard[24].

Admissibility According to the Helpfulness Standard:

The Federal Rules of Evidence, without explicitly rejecting the Frye rule, offer a more flexible approach. Rule 702 specifies that if scientific, technical, or other specialized knowledge can assist the fact-finder in comprehending the evidence or resolving a factual issue, a qualified expert, possessing knowledge, skill, experience, training, or

[23] *Fry Standard*, LAW CORNELL, (14th October, 2023, 8:55pm) https://www.law.cornell.edu/wex/frye_standard#:~:text=Frye%20Standard%20is%20used%20to,1923

[24] 509 US 579, 113 S.Ct. 2786 (1993)

education, may present their opinions or expertise. In determining admissibility, Rule 702 should be considered in conjunction with Rule 403, which requires the court to weigh the probative value of the evidence against its potential for misinterpretation by the jury.[25] In making this determination, the court should evaluate the reliability and soundness of the process or technique employed in generating the evidence, the likelihood that introducing the evidence might overwhelm, confuse, or mislead the jury, and the demonstrated connection between the scientific research or test result to be presented and the specific contested factual issues in the case.[26]

In the case of People v. Castro, the New York Supreme Court conducted an extensive 12-week pretrial hearing to thoroughly examine various issues related to the admissibility of DNA evidence. Castro is charged with the murder of his neighbor and her 2-year-old daughter, with a focus on whether the blood found on Castro's watch matches that of the victim. The court's rulings in this case are as follows:

- DNA identification theory and practice are generally accepted within the scientific community.
- DNA forensic technology has gained widespread acceptance among the scientific community.

[25] Rules 401, 402, 403 and 702, Standard of the Federal Rules of Evidence
[26] *Use of DNA information in the Legal System*, NCBI, (15th October, 2023, 9:00 pm) https://www.ncbi.nlm.nih.gov/books/NBK234535/

A pre-trial hearing is essential to determine whether the testing laboratory's methods adhere to scientific standards and yield reliable results that can be considered by a jury.

This case supports the argument that inclusionary DNA identification evidence is more likely to be accepted than exclusionary DNA identification evidence. In Castro, the court allowed a DNA test to demonstrate that the blood on Castro's watch was not that of the victim. However, it did not allow the test to prove that the blood was the victim's. Furthermore, the court recommended broader discovery requirements for future procedures, including the provision of copies of all laboratory results and reports, interpretation of statistical probability calculations, disclosure of any observed defects or laboratory errors (including contamination), and the establishment of stringent record-keeping standards.[27] These recommendations were subsequently expanded upon by the Minnesota Supreme Court in Schwartz v. State[28], emphasizing the importance of providing the defendant with access to data, methods, and actual results for independent expert reviews. In 1996, the National Institute of Justice published a book titled "Conviction by Jury and Scientific Innocence," which recognized the role of DNA technology not only in securing convictions but also in exonerating individuals wrongfully accused in criminal cases.

[27] (1985)- 211 Cal. 3d 301
[28] 447 N.W. 2d 422 (1989)

Conclusion:

In conclusion, DNA profiling has emerged as a powerful tool in both criminal and civil cases, offering a high level of accuracy in proving identity and family relationships. It can complement traditional forms of evidence, especially in criminal cases, by narrowing down suspects and strengthening the case against potential perpetrators. However, its acceptance in Indian courts varies depending on the type of case, with more routine use in criminal cases and specific circumstances in marriage or parent-child disputes.

On the other hand, the ethical implications of using substances like alcohol and marijuana on suspects during interrogations, with the aim of loosening tongues and extracting confessions, raise concerns. This practice can lead to hallucinations and delusions, potentially distorting the reliability of confessions and evidence. Similarly, DNA analysis conducted without the defendant's cooperation, forcibly removing evidence from the individual, presents a significant violation of human rights.

The need for legal reforms and amendments to accommodate advancements in science and technology, such as DNA profiling, is evident. While other countries have enacted specific legislation to address DNA evidence, India has yet to adopt comprehensive laws in this regard. The existing legal framework has seen some interpretation and minor amendments, but a comprehensive approach to include DNA evidence in the Indian legal system is still lacking. As science and

technology continue to advance, it is crucial for legal systems to keep pace and ensure justice is served effectively and ethically.