

DNA EVIDENCE AND CRIMINAL INVESTIGATION: RECENT DEVELOPMENTS AND LEGAL ISSUES

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ABSTRACT:

In all the cells of the human body, the fundamentally existing genetic material is Deoxyribonucleic Acid (DNA). The DNA of every single person varies from one another. In criminal assessment, the DNA evaluation has been utilized as vital evidence. It is also employed in cases concerning the ascertainment of Paternity of Identity in civil proceedings. The court constantly depends upon the accurateness, lawful accumulation, protection, along with certification of the DNA evidence's admissibility. The court is convinced of this evidence because of its trustworthiness. An act done by an individual without criminal intention is not termed a crime. In civil along with criminal cases, the DNA assessment has turned into a highly significant task. Conversely, to support investigators together with courts in cases including DNA evidence, no particular law is available in India. Thus, a person is alleged or removed from doubt with the DNA evidence as collected from the scene of Crime. Several methodologies utilized for the recognition of DNA evidence are surveyed in this work. There would be remains of biological proofs like skin cells, hair, blood, or semen available on victim's body at the scene of the Crime. The collection and processing of such biological samples for gathering DNA Evidence is a complex and has to be meet certain legal standards to be admissible. The aim of this paper to make a review of the evidentiary value of DNA as collected and processed from the Crime scene

Keywords: *Forensic science, DNA evidence, DNA detection, DNA error detection, admissibility of DNA, Evidentiary value of DNA, DNA database.*

1. INTRODUCTION

The Criminal investigation process involves collection and processing of various biological samples from the scene of Crime.¹ The Forensics Professionals are supposed to provide the evidence in the court and they are asked for assurance after giving the evidence.² The crime being charged in a criminal case is evidenced via direct or indirect proof. Nevertheless, for a specific case, the entire evidence being collected may not be pertinent to it.³ In the department of forensic, the initial step for the recognition of identity is the analysis of the ABO blood group system. Consequently, regarding the difference in serum proteins together with red blood cell enzymes, a new symbol is produced for the identity along with paternity detection. In due course, the human leukocyte antigen methodology was also utilized. More than 2 decades ago, DNA-based identity testing was first introduced by Sir Alec Jeffreys, a professor as well as a geneticist at the University of Leicester in the United Kingdom (UK). After that, the years been followed had rapid growth in the usage of DNA to forensic issues.

Subsequently, now, one of the significant instruments utilized by forensic biology experts is DNA⁴. The DNA of every single person is varied. In criminal cases, DNA evaluation has developed into a significant form of evidence. In the forensic department, utilizing several sequencing methodologies, the forensic DNA phenotyping is introduced for two reasons: (i) The previous method of identification based on blood grouping method was found to be inadequate and subjected to criticism.; (ii) DNA Evidence has proven to be acceptable as an evidence to establish identity of individuals.⁵ Numerous biological specimens can be evaluated with the advancement in DNA extraction along with amplification technologies to obtain vital biological evidence.⁶ Identification, phenotype, kinship, surname, bio-geographic, mixture evaluation, ancestry, and trace evidence evaluation are certain applications included in the evaluation of forensic DNA.⁷

The DNA as extracted from the biological samples would be analysed to establish identity by comparing with an available reference sample of the suspects by the investigators.⁸ Presently, in most countries, there exist databases which maintain DNA Samples as collected and processed from Crime Scenes to be used for future investigations. There have been discussions among the countries to enter into International Agreements for transnational exchange of DNA Evidence to overcome cross-border crimes like human trafficking, sex, illegal immigration, along with terrorism.⁹ A person's identity together with the physical features, sex, place of origin, and ethnicity are detected accurately utilizing the method of DNA evaluation. The DNA investigations available now are acknowledged as legal evidence in courts owing to their higher trustworthiness.¹⁰ However, there are certain issues involved in the admissibility of DNA as an Evidence in Courts and this review paper is an attempt to analyse these such issues.

2. DNA as a Forensic Tool and the potential to establish identity

A considerable contribution has been given to criminal testing by the DNA evidence. In the past decade, numerous techniques have been evolved. The deliberations intended for criminal justice, developments along with potential inferences are illustrated below.

MinnaJoki-Erkilet *al.*¹¹ in the research have suggested a collection procedure for forensic evidence.. In the procedure, the researcher has suggested that to detect Y-DNA along with spermatozoa as of a urine specimen, Buccal Swab Spin Protocol can be employed. The current procedure can be used to reduce time delay in child sexual cruelty cases. The procedure as suggested can be used in sexual assault cases in which the specimens obtained are mixed and this methodology can be utilized to differentiate the male along with female DNA.

JacklynBuscaino *et al.*¹² recommended a Rapid DNA Evaluation intended for the processing of DNA specimens attained from the Crime Scene. For the human DNA being extracted, the RapidHIT ID System was performed. The turnaround time was enhanced along with the operator contamination threat was decreased by simplifying together with integrating the regular steps. The proper estimation in conjunction with the validation of the potential inhibitors' consequence that occurred in the decontaminated DNA was significant for forensic laboratories. To determine the usage of these cartridges in a conventional forensic laboratory, the purified along with quantified DNA from crime scene specimens were utilized. However, the methodology had a huge threat of contamination.

Rebecca Campbell *et al.*¹³ developed rape kits' DNA analysis to detect alleged serialized sexual criminals. In this review, the data about the sexual offense registered to the criminal justice system, which was detected via forensic DNA evidence in rape kits were added to the criminal history records. To detect together with validating a 4-class system of alleged serialized sexual offenders spanning ages 16 to 60, the growth mixture techniques were utilized. The 4 classes were differentiated in the number of sexual crimes done by every single offender together with the ages of offending. The sexual crimes detected via rape kit testing along with criminal history records were added in all the classes. The police would get an exact image of offenders' criminal activities by the DNA evaluation together with the criminal history verification on detected criminals as standard inquiry practice. But, owing to stereotypic partiality about victims, the case abrasion was heavy. It is also recommended forensic DNA evidence for detecting suspected serial sexual perpetrators. In this, the outcomes of forensic DNA testing obtained as of a SAK's sample were investigated. Subsequently, it was determined if the case was associated with any other sexual crime registered in the criminal history records. Nearly 35.7 percent of the offenders in this sample had more than 2 sexual crimes connected through DNA, which was greater than that registered in court records (8 –15%). The connection of forensic DNA evidence with numerous sexual crimes to the same offender was spotlighted by the 3 case studies presented. The law enforcement officers should investigate the number of alleged serial sexual criminals detected as suspected serial instead of isolated incidents; in addition, should verify the criminal history record for detected offenders.

Joshua Chan Munet *al.*¹⁴ introduced a calculation for a possible ratio that utilized NGS (Next-Generation Sequencing) information meant for DNA evaluation on sample mixtures. Nearly, 4480 DNA mixtures possessing different mixture ratios of 8 disparate whole-genome sequencing data were estimated utilizing this methodology. In criminal investigation, there would be a need for better quality of DNA to be extracted to be used as Evidence. The probability of employing Next Generation Sequencing data in DNA mixture analysis was proved by the outcomes being obtained. For 2-person mixtures, a mean ratio of 285978 was monitored. The entire 224 detection tests intended for 2-person along with 3-person mixtures were perfectly detected utilizing this methodology. Nevertheless, it was whispered that the system would be capable to separate the little inconsistency betwixt related persons owing to a huge number of indicators besides the human genome.

Athina Vidakiet *al.*¹⁵ recommended body fluids DNA detection for specific kinds of CS evidence. For forensic tissue detection, the DNA methylation indicators were utilized. The existence of particular body fluids could be connected with specific kinds of crime, for instance, the existence of semen might point out sexual crime. Generally, the DNA methylation models were clearly illustrated by the semen, which in turn could be detected with assurance. In mock casework, the 2 semen-specific indicators provided better performance. Additionally, for up to 16 years, their DNA methylation profiles were constant in semen stains. Nevertheless, the body fluids' smaller dataset along with tissues was gathered.

3. Admissibility and Relevancy of DNA Evidence

DNA interpretation is highly admissible and also provides perfect identity.¹⁶ In court, the DNA evidence's admissibility is relied on the proper collection, accuracy, preservation, along

with documentation, which convinces the court. In India, no specific legislation or procedure is available to give proper rules to the investigators together with the court to utilize in the cases comprising the DNA evidence. Furthermore, to handle the difficulties in science, technology along with forensic science, no particular provision is provided underneath the Indian Evidence Act, 1872 and Code of Criminal Procedure, 1973. An investigating official has to experience more complications in gathering evidence to demonstrate the charged person guilty in consequence of the shortage in such provision. In this part, the forensic specialists or odontologists are made awake of the DNA evidence's admissibility in court by highlighting the laws allied with the evidence's admissibility worldwide. It also has a special focus on the laws related with the evidence's admissibility in the judicial system.

The investigating executive is authorized to gather a DNA sample as of the offender's body together with the wounded with the physician's aid under the Cr.P.C. by the Cr.P.C. (Amendment) Act, 2005. In this portion, the person charged with rape and the rape victim is investigated medically by the physician. Since the Supreme Court accompanied by the high courts' opinion in judgment stayed contradictory, the evidence's admissibility has remained ambiguity. The DNA testing's scientific accuracy together with the conclusiveness is not refused by the adjudicators. However, this proof is not permitted in specific cases via legal prohibition accompanied by the public policy. To handle science along with technological problems, there is a vital need to reconsider these laws as there are no guidelines available in the aforementioned acts.

4. Probable Errors Associated with the Use of DNA Evidence and Need for Standardization

The problem of scientific standardization of DNA technology has been resolved. However, since DNA expert is yet to be legally identified under the Indian lexicon mostly Section 45 of the Indian Evidence Act, 1972, along with Section 293 of Cr. PC, the legality of DNA evidence is questioned in the courts. Numerous right-centered problems namely privacy along with protection against self-incrimination are encompassed by DNA profiles. Before ordering to offer a DNA sample, judicial appreciation of the situation on a case-to-case basis is needed.¹⁷ Statistical problems are examined by this volume in understanding frequencies as possibilities, comprising adjustments when a suspect is found via a database search.¹⁸ The probable errors with DNA are illustrated in table 1.

Table 1: Probable errors with DNA

<i>Problems with DNA</i>	<i>Legal issues</i>
allelic dropout, stutter bands, and silent alleles when interpreting STR DNA	Contaminants or other unintended DNA to an evidence sample could be problematic. Penalty for destruction, alterations, contamination, or tampering with biological evidence. ¹⁹⁻²²
low-template DNA (LTDNA)	
Low template (LT) DNA mixtures	
Multiplex STR amplification of UV-damaged DNA.	

Drop-out of STR alleles	False detection of characteristics that did not come as of contributors — a phenomenon called the allelic drop-in, and the test results might be distorted in other ways that complicate interpretation.
short tandem repeat data in DNA mixtures	
Drop-out, Pr(D) and drop-in, Pr (C)	
twin phenomena of drop-out and drop-in	
Low template DNA	Issues commonly seen with low template samples – would further complicate profile interpretation. Although DNA evidence has long been regarded as the gold standard of forensic science, lawyers should not assume that the tests were performed or interpreted properly in every case. ²³⁻²⁴
DNA replication	
Complex low template DNA profiles	
allelic drop-out	
low template DNA	
Mixed DNA Profiles	Separation of the contributors to a mixed DNA profile into major and/or minor contributor profiles. Deconvolution is typically based on quantitative peak height information and may depend on underlying assumptions (e.g., whether the sample has been deemed an intimate sample). ²⁵
mixed DNA profiles	
allelic dropout	

5. CONCLUSION

The growth in DNA evidence along with the legal problems in utilizing this evidence is surveyed in this paper. The novel scientific methodologies along with an assessment of experiential evidence about the involvement of DNA evidence in criminal cases are also included. In this paper, the modern methodologies together with their applications are spotlighted. In criminal justice procedure, the involvement of DNA evidence is being illustrated by the case commandment along with the empirical evidence. These advantages are also helpful in civil cases like the detection of fatalities in disasters. With the aid of several human body specimens, the DNA evidence detection methodologies are exposed in this study. Consequently, it is highly complicated to make particular suggestions about a threshold dose in which the forensic processing together with revealing personnel to a dangerous location to gather the evidence is meaningless. To find the suspects along with connecting the suspects to a crime, confirming that they were at the crime place, this procedure is utilized. The accurateness of the criminal system is advanced by DNA profiling. Additionally, the involvement of novel methodologies like familial searching, mtDNA profiling, and Y-STR profiling in the investigation; in addition, the advantages of trial outcomes of individual cases are determined. The involvement of large-scale databases in processing the available evidence is examined further. In this paper, several methodologies that are involved in criminal investigations are reviewed. Nevertheless, the strength of DNA

profiling is influenced by certain complications like the extrapolation of statistical estimations from subpopulation databases, the weight provided to DNA evidence in indirect cases, along with sample contagion. DNA evidence is considered as the prime evidence in a case regardless of the technological enhancements.

Declarations of interest:

None

Funding:

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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