



# CRITICAL STUDY OF BIOTECHNOLOGY AND HUMAN GENETIC DIVERSITY FOR ITS USES IN FORENSIC INVESTIGATION

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**Abstract:** Forensic Science enhance and strengthen the Intellectual Property. The new Regime of Law that supports in search of facts and aspirational suggestions and acts as a tool assisting in the detection of Crime and Helping the Criminal Justice System in bringing the culprit the book. The Methods and Procedural Measures moves forward the case in a jurisprudential principles. The New Techniques and Measures Makes it valid. Forensic Science as a tool for assisting in the detection of crime and helping the Criminal Justice System in bringing the culprit the book, appears to be finally coming of age in India. Recently, the Hon'ble Supreme Court while passing orders in a writ petition on —Speedy Trial of under Trial Prisoners has recorded its concern about the large number of trial held up due to delays in Forensic Science Laboratories. Forensic Science is a multi-disciplinary subject which borrows from disciplines is diverse as Physics, Chemistry, Biology, Computer Science, Psychology and Phonetics. Through a combination of scientific applications in these areas of knowledge, Forensic Scientists aspire to find methods and solutions for recovery and collection of evidence from scenes of crime, so as to ensure that criminal evidence is recovered and retained without being contaminated and altered, packed and sent in a scientific and safe manner to the lab where the latest techniques are deployed and applied to extract prosecutable evidence that will link the evidence to the scene of crime and finally to the criminal so that he or she may be successfully prosecuted. As society moves towards more scientific response to solving crime that is more in sync with the human rights environment today, Forensic Scientists will continue to increasingly become an important part of the process to dispense justice. Forensic Scientists have to regularly face a more tech savy criminal and a more well informed and equipped defense. Over the last many years, the work and opinion of the Forensic Scientists has been used to develop new laws and jurisprudence by courts in the country. This compilation discusses the few cases wherein the Hon'ble Supreme Court has discussed the applications and scope of Forensic Science.

**Index Terms – Biotechnology, Genetics, Jurisprudence, Profiling.**

## I. INTRODUCTION

The literature Identifies how does biotechnology helps the forensic scientists solve crimes. Playing a vital role to prove innocence in court and determining the parentage. Over the years, the judiciary in India has posed great faith and hope in forensic component of evidence collection for revealing the truth necessary in the administration of justice. The judicial approach, in determining paternity disputes, underwent an evolutionary progression and currently places high reliance on DNA 'in pursuit of truth' rather than 'legal fiction of legitimacy' despite the fact that the percept is contrary to the existing law. The forensic techniques need in-depth right based analysis and discussion by legal and intellectual brains from various quarters such as judiciary, academia, legislators and civil society.

## I ORIGINATION

The course of molecular forensics changed in 1984, when geneticist Alec Jeffreys, of the University of Leicester in the United Kingdom, discovered a new type of marker in the human genome. He found that our DNA contains many noncoding regions in which a sequence of 10 to 100 base pairs is repeated multiple times. Although the sequence is usually the same at each region in all people, the number of times that the sequence is repeated is highly variable among individuals.

Jeffreys immediately saw the potential for forensic use of these markers, which he called "minisatellites." In less than two years, forensic labs across the world could create DNA "fingerprints" of crime suspects by profiling their unique minisatellite makeup. For the first time, forensic scientists could create genetic profiles so specific that the only people who share them are identical twins.

DNA fingerprint techniques evolved subtly over the next several years, until the polymerase chain reaction (PCR), developed by Kary Mullis, was introduced into forensic work. By allowing the selective amplification of any desired stretch of DNA, PCR ushered in unprecedented sensitivity in low-level DNA detection at crime scenes. All of today's forensic genetic methods are based on PCR.

## II WHAT IS BIOTECHNOLOGY

IT is a technology based biology that harnesses cellular processes to develop technologies and products that help improve our lives and the health of our planet.

## III HOW IS BIOTECHNOLOGY USED

Can be used by forensic scientists to collect process trace evidence such as hair saliva blood samples which is found in crime scenes.

### INVISIBLE EVIDENCE

Forensics scientists use biotechnology techniques to help detect important evidence. A chemical called luminol glows brightly in the presence of blood so detects small amounts of blood that are not visible to our naked eye. Each person has DNA and DNA can be at a crime scene in small samples and from skin and hair to bacteria in dirt. Small amounts of DNA is Found as technique like microscopic analysis, Mass spectrometry, chromatography and DNA analysis are done.

### CATCHING A CRIMINAL

Modern forensic evidence is used with DNA Fingerprints and sources of DNA, like hair, saliva, blood, bone and tissue samples. The samples collected from the crime scene might match the DNA of a suspect was at the crime scene does not prove the suspect committed crime. Innocent until proven guilty.

### DNA FINGER PRINTING

Forensics also use DNA Profiling or genetic finger printing. DNA Finger printing creates a pattern based on an Individual's unique DNA, Which can be used as an Identifier for a person. DNA Finger printing distinguishes individuals using samples of their DNA, so is has become one of the most powerful tools of the forensic scientists enabling law enforcement personnel to match biological evidence from crime scene to suspect.

### DNA SEQUENCING

In case where samples are highly degraded, Forensic scientists often turn the most powerful DNA sequencer which allows to analyse old bones or teeth to determine the specific ordering of the person's DNA bases and generate a unique DNA pattern that can help Identify that person as possible suspect or client.

## IV WHAT CAN DNA FINGERPRINTING BE USED FOR?

Genetic finger printing used in forensic science to match suspects. Genetic fingerprinting is also used for identifying human remains, testing for paternity, matching organ donors, studying populations of wild animals, and establishing the province or compositions of foods. It has also been used to generate hypothesis on the pattern of human migration.

## V WHERE IS DNA FINGER PRINTING IS USED?

DNA Finger printing is used in criminal Investigation Family history and paternity case Archaeology and Palaeontology  
 Classification of Plants and animals  
 Medical diagnostics  
 Summary the DNA Profiling

Step1: DNA must be obtained from the samples

DNA must be isolated from blood cells in blood stains from broken glasses, hair found on brush, skin scratched during a struggle and many other sources.

2.DNA extracts from the sample

The DNA is then Purified by either chemically washing away the unwanted cellular material or mechanically used pressure to force the DNA Out

3.DNA strands are cut into fragments

The Pieces are separated from electrophoresis. The DNA is incubated with a radioactive probe, processed somemore and then transferred to a film

This fingerprint is compared with others stored in computer databases until a difference in pattern is noticed.

In 2014, the Nandlal Badwaik has set the tone for courts to pierce

Over the years, the judiciary in India has posed great faith and hope in forensic component of evidence collection for revealing the truth necessary in the administration of justice. The judicial approach, in determining paternity disputes, underwent an evolutionary progression and currently places high reliance on DNA 'in pursuit of truth' rather than 'legal fiction of legitimacy' despite the fact that the percept is contrary to the existing law. It is submitted that in parentage determination, the judiciary, in pursuit of truth, has transgressed the legal boundaries of section 112.

Few Technical concepts of terms used: The standard genetic forensic test used in crime labs across the world assays an individual's profile of markers, called short tandem repeats (STRs), which are genetic sequences similar to minisatellites, although the repeating DNA sequence in STRs is considerably shorter. STRs are equally variable among individuals: with each additional STR locus a forensic scientist analyzes, the odds become vanishingly small that two people will have the same STRs at all loci.

Most human forensic casework is performed with standardized commercial "multiplexes" that assay STRs at multiple genetic loci simultaneously. The ease with which STR profiles can be typed today has led to the development of large national databases containing STR profiles of millions of people suspected or convicted of crimes. In the United States, the DNA Identification Act of 1994 authorized the Federal Bureau of Investigation to create a national DNA database: the Combined DNA Index System (CODIS). CODIS originally consisted of a forensic index, which contains DNA profiles from crime-scene evidence, and a convicted offender index, which contains profiles of DNA samples taken from convicted offenders. In the past several years, CODIS has added indexes for arrestees and missing persons.

Criminal investigators can query CODIS with STR profiles taken from biological samples found at a crime scene. If the crime-scene sample matches a profile in the offender database, this information can lead police to a likely suspect, or exonerate an innocent suspect. By searching the forensic index, investigators can link crime scenes together if they find the same person's DNA at both scenes.

The standard DNA profile collected in the United States and entered into CODIS consists of 13 STR loci plus the amelogenin gene, which is found on the X and Y chromosomes and can establish the sex of unknown sample sources. The probability that two unrelated individuals share the total profile is less than one in one trillion. CODIS currently contains nearly 6 million STR profiles, says John Butler, of the National Institute of Standards and Technology.

Database of Prisoners

The United Kingdom's National DNA Database, which contains more than 4 million profiles, collects samples from individuals arrested for all but the most minor offenses. In England and Wales, but not Scotland, profiles stay in the database even if the arrestee is never charged or is acquitted in court. "There's some debate going on at the moment" about this policy, however, says Peter Gill of the UK's Forensic Science Service. Two British men who were arrested for a crime but later cleared are petitioning the European Court of Human Rights to have their DNA removed from the database. "It's possible that some of these profiles may have to come off if the court finds that they're illegal," Gill says. DNA database rules differ in other countries. For example,

DNA samples in the Netherlands are entered only for those who are serving jail sentences longer than four years, and then profiles are removed 20 to 30 years after conviction.

Laws also differ concerning preservation of DNA samples themselves. In some US states, only the STR profile is kept; the DNA samples themselves are destroyed after analysis. In many states and in England, however, DNA samples are preserved indefinitely, for possible analysis with technologies not yet invented. In some countries, investigators now search DNA databases not only for full matches but also for partial matches to STR profiles. A partial match indicates that the perpetrator may be a close relative of the person found in the database. Such “familial searching” is “pretty routine in the UK,” says Gill.

I Y chromosome mDNA and New directions of finding through RNA.

For example, researchers are now establishing useful markers on the Y chromosome. Such markers do not have as much statistical power as traditional STRs to make unique identifications, as Y sequences are much less diverse between individuals.

to develop a profile of useful single- nucleotide polymorphisms (SNPs). Because SNPs differ from each other at only one base pair, they are the smallest genetic markers possible.

The primary disadvantage of SNPs is that they do not exist in as many different varieties as do STRs, and therefore their power for making unique identifications is considerably less. Approximately 50 SNPs are required to identify an individual with the same certainty as with the standard 13 STRs. For this reason, SNP use in forensics will probably remain relatively specialized, Butler says.

II Mitochondrial DNA (mtDNA) can also be extremely useful for identifying degraded DNA. Mitochondrial DNA is found in the cell's mitochondria instead of its nucleus. Because there are hundreds of mitochondria per cell, there are also hundreds of copies of the cell's mtDNA, which increases the chances that it will survive long time periods or harsh conditions. For this reason, mtDNA analysis is widely used in historical analyses of bones and in cells with little DNA, such as hair shafts.

Mitochondrial DNA is found in both females and males but is inherited only through the mother, which makes it less varied than nuclear DNA. Like Y chromosomal markers, mtDNA “doesn't have nearly the exclusion power” of standard STRs, Foran says. But, “when you can't get anything else, you can often get mitochondrial DNA.”

Biological fluid analysis in particular is of great interest to forensic scientists. Researchers have recently shown that RNA profiles of blood can differentiate between menstrual blood and blood found in blood vessels, a distinction that may be important to investigators trying to determine the origin of blood stains in someone's home. Messenger RNA markers have also been identified for saliva, semen, and vaginal secretions. By profiling mRNA contributions from a crime-scene sample, investigators should be able to tell what type of fluid they're working with. In sexual assault cases, this knowledge “might be very important to determine if a sample is coming from semen or from saliva or blood or skin,” McCord says.

The advent of the tDNA (touch DNA), mtDNA (mitochondrial DNA), Ychromosome analysis (Y- STR) and RNA analysis are yet other refinements in the technology of DNA forensics having promising future in criminal justice system to help in stitching crime with the criminal with more precision, minimizing speculation leading to wrongful conviction. It is evident that in the western world, despite having advanced tools of investigation, cases of wrongful conviction have been reported leading to miscarriage of justice. Cases of false accusation and wrongful conviction based on prejudiced oral testimony and defective investigation remain a great challenge in India due to socio-economic stratification and prevalent corrupt practices existing in criminal justice system. It is submitted that the legislature and judiciary may give due consideration to introduction of integrated justice model to correct miscarriage of justice with the help of advanced forensic technology.

III DNA in service matters Interestingly, DNA forensics has entered the courtroom to render justice in service matters as well. The High Court of Calcutta received an appeal related to the termination of services of the petitioner, an airhostess working as a cabin crew, on the ground that she was overweight. The trial judge upheld the order of termination being found in accordance with the due process of law. In appeal, the court relying on the Supreme Court decision in *Sheela Joshi v. Indian Airlines Ltd.* took assistance of DNA technology to ascertain the status of gene named fat mass and obesity-associated (FTO) gene responsible for increased body mass index (BMI) being primarily responsible for causing obesity and accordingly provided relief to the appellant. This case reminds one of the legal struggle of female officials to protect right of equality in public employment as earlier contested in *Air India v. Nargesh Meerza and C. B. Muthamma v. Union of India*. DNA evidence in criminal cases for victim identification In criminal matters, DNA profiling has multi-fold applications. It not only helps in cracking cold cases and linking crime with criminals with more precision but also help in identification of victims in many cases. In many cases, the victims are killed and after lapse of time, it becomes difficult to connect recovered body remains with the victim. In such situations, DNA technology is a globally reliable and admissible forensic tool. DNA may also further help in proving of innocence of the accused in case of false accusation and wrongful conviction. DNA has helped the Indian judiciary in connecting crime with criminal and identification

After lapse of one year, the skeletal remains of the deceased were recovered by police under section 27 of the IE Act,<sup>53</sup> buried underground in the house of the accused. On the issue of 'custody' under section 27, the court further clarified: The expression "custody" which appears in Section 27 did not mean formal custody, which includes any kind of surveillance, restriction or restraint by the police. Even if the accused was not formally arrested at the time when the accused gave the information, the accused was, for all practical purposes, in the custody of the police. This Court in *State of Andhra Pradesh v. Gangula Satya Murthy (1997) 1 SCC 272* held that if the accused is within the ken of surveillance of the police during which his movements are restricted, then it can be regarded as custodial surveillance. Consequently, so much of information given by the accused in "custody", in consequence of which a fact is discovered, is admissible in evidence, whether such information amounts to a confession or not. Reference may also be made to the Judgment of this Court in *A.N. Venkatesh v. State of Karnataka (2005) 7 SCC* 714.

In *Sandeep v. State of Uttar Pradesh (2012) 6 SCC 107*, this Court held that it is quite common that based on admissible portion of the statement of the accused, whenever and wherever recoveries are made, the same are admissible in evidence and it is for the accused in those situations to explain to the satisfaction of the Court as to nature of recoveries and as to how they came into the possession or for planting the same at the place from where they were recovered.

Reference can also be made to the Judgment of this Court in *State of Maharashtra v. Suresh (2000) 1 SCC 471*, in support of the principle. Court emphasis on capacity building for law enforcement agencies In 2014, the judiciary seemed concerned on the quality of investigation and accentuated upon capacity building for the investigating agencies and prosecutors especially in relation to forensic tools.

In the *State of Gujrat v. Kishanbahi*, 68 the Supreme Court categorically emphasised on training for investigators and prosecutors handling sensitive matters. The importance of capacity building for improving investigating skills of police personnel was emphasized by the High Court of Jharkhand which held, "The Principal Secretary, Home is directed to ensure that the Police Officers of the Jharkhand Police shall be given intensive training as to how scientific investigation is to be done and how to collect finger print, blood stained earth and other incriminating articles so that successful scientific investigation can be done to find out the truth and to apprehend the actual culprit. Imparting training also comes within the duty of the Forensic Science Laboratories"

## RESEARCH METHODOLOGY

This article would be a doctrinal based research methodology. There are various methodologies used in this article, including Content Analysis Method with secondary data collection from books and articles. The methodology that is being adopted in the said project is purely doctrinal in nature. The research is completely relying on primary resources, such as statutes and also secondary resources such as notices, commentaries and various books of eminent authors have been referred and cited. The said research paper also has a high reliance on the study articles and other works of eminent universities/colleges and also websites have also been referred which can be viewed in the Reference.

### 3.1 Hypothesis

Investigation of crimes without forensics is impossible to be a null hypothesis where as new methodologies used is alternative hypothesis. The literature 40% deals with the history of past usage of biotechnology genetics and genomes for the use of Forensics 60% about the methodologies tries n criminal Investigations and case studies as well useful in the leaning analysis to fetch the results.

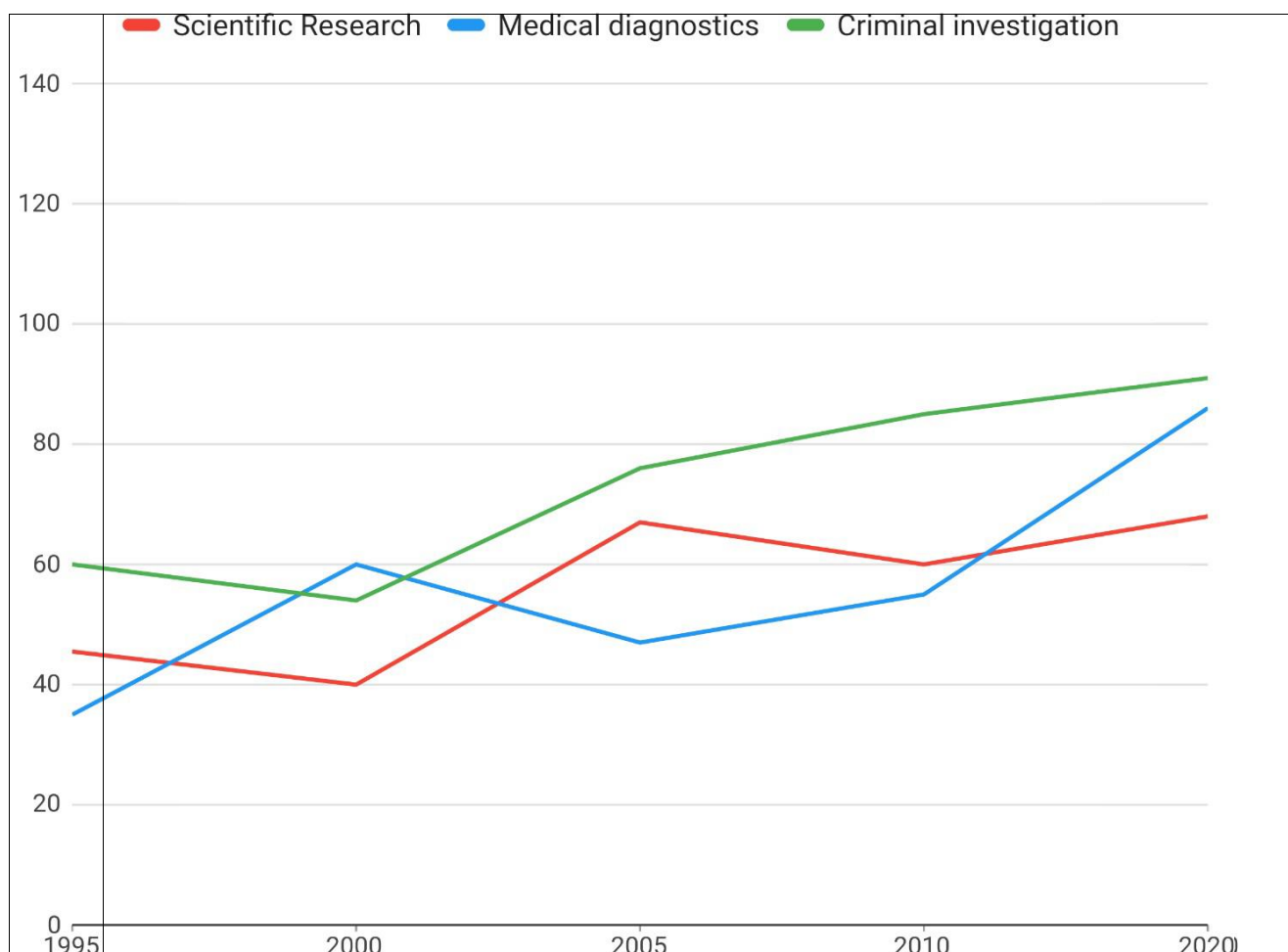
### 3.2 Analysis

Table one talks about the Techniques that is comparatively used across the nation for the purpose of Forensics in order to identify the suspect in the crime scene. Most used biotechnology that is used in criminal Identification in 2005 to 2020 consequently the techniques increasing to make smart identification for the proper criminal Investigation. The techniques shown in the figure were DNA fingerprinting, DNA profiling was legalised from 2005 in India and RTFL Polymerase Chain reaction STR further thirdly mt DNA, RNA and chemicals used probably the new directions comparatively thrid technique is found to be lesser in number than quite often used to make the suspect a convict or to prove innocent of guilty.

## Research analysis

TABLE 1 EXPLAINING THE WIDESPREAD OF USAGE OF BIOTECHNOLOGY RESOURCES AS A RESEARCH RESULT TO IDENTIFY THE SUSPECT FROM THE COMMITTED PLACE OF OFFENCE. SCIENTIFIC RESEARCH AND MEDICAL DIAGNOSTICS SURVEYED DURING THE YEARS 1995 TO 2020

Table 1 Table Type Styles



## II. SUGGESTION AND ACKNOWLEDGMENT

The IIIT-A has acquired a rare efficiency in producing DNA finger-printing in just five to six hours. A special forensic lab which has been established at the Indo-Russian Centre for Biotechnology at IIIT-A is well embellished with latest DNA synthesizer and decoders, besides cold room, deep freezers and mega computational equipment needed for the complex work. "A delegation of Delhi High Court during a recent visit to participate in a seminar on IT tendered a proposal to IIIT-A for establishing a state-of-the-art DNA finger printing laboratory in order to expedite the pending cases particularly related with DNA finger-printing in the courts and aid in the overall early decision making process," informed Director of IIIT-A, Dr MD Tiwari. He, however, said that that proposal was aborted due to legal complexities which are embedded in the procedure of unwinding the codes. Dr Tiwari said that the present forensic lab of IIIT-A is capable of producing the DNA finger-printing results within five hours unlike the long duration being taken by most of the other institutions including the Centre for Cellular and Molecular Biology (CCMB), Hyderabad which are taking up a month and more for the same work. (Hindustan times ,Newdelhi)

While traditional forensic genetics has been oriented towards using human DNA in criminal investigation and civil court cases, it currently presents a much wider application range, including not only legal situations *sensu stricto* but also and, increasingly often, to preemptively avoid judicial processes. Despite some difficulties, current forensic genetics is progressively incorporating the analysis of nonhuman genetic material to a greater extent. The analysis of this material—including other animal species, plants, or microorganisms—is now broadly used, providing ancillary evidence in criminalistics in cases such as animal attacks, trafficking of species, bioterrorism and biocrimes, and identification of fraudulent food composition, among many others. Here, we explore how nonhuman forensic genetics is being revolutionized by the increasing variety of genetic markers, the establishment of faster, less error-burdened and cheaper sequencing technologies, and the emergence and improvement of models, methods, and bioinformatics facilities. (Arenas M, Pereira F, Oliveira M, Pinto N, Lopes AM, Gomes V, et al. (2017) "Forensic genetics and genomics: Much more than just a human affair." *PLoS Genet* 13(9)

Future development perspective view seems as per latest estimates, thousands of cases are pending at the central forensic laboratories of the country for the DNA finger-printing reports. The pending reports are believed to be the root cause of the delay in taking the final decision over the court cases. The father of DNA finger-printing in India Prof Lalji Singh, who is presently director of CCMB-Hyderabad, has personally paid a visit to the IIIT-A lab and praised its efficiency and capability. The forensic laboratory is being continuously upgraded according to the need of research, and latest equipment of estimated cost of Rs 20 lakh were augmented just a few weeks back. "A proposal has been forwarded to the Union Ministry of HRD for upgrading the

laboratory further". IIIT-A is confident of remaining active in rendering service to the nation in solving the mystical maze of crime through these ultramodern techniques.

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