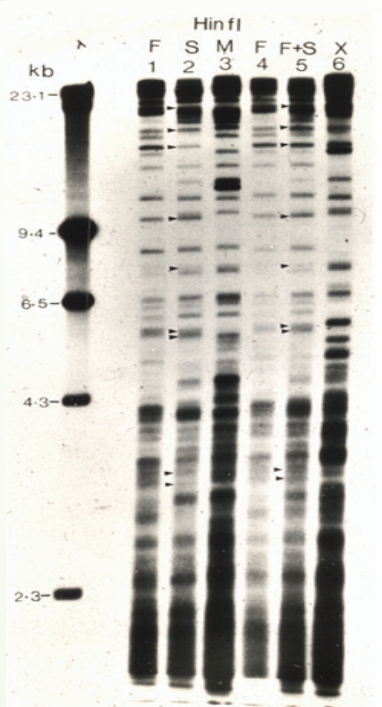




**80 YEARS OF
IMPACT**

**Council of Scientific &
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DNA Fingerprinting Technology — Its Success and Future



CSIR-CCMB's first DNA banding pattern seen among different individuals using DNA fingerprinting technology

SOME proportion of the DNA sequence of every individual is unique. There are probes that can find such unique DNA sequences and generate individual-specific DNA profiles. This can be visualised as bands by molecular

biology techniques. In 1988, CSIR-CCMB scientists developed indigenous probes for DNA fingerprinting and took this technique to the users. India, thus, became the third country in the world to develop its own DNA fingerprinting probe.

The technique was a fallout of the basic research on the molecular basis of sex determination in snakes. The probe was obtained from the minor satellite DNA of the Indian banded krait snake. And they found that the probes from snakes could work on human DNA too. The scientists found individual-specific DNA banding patterns using these probes. Thus, it could be used for establishing the identity of people as fingerprints and handwriting of people have been used more traditionally.

In 1991, DNA fingerprinting evidence was presented in the Kerala High Court in a paternity dispute case. And for the first time in the annals of the history of the Indian Judiciary, it was accepted as infallible evidence in the court of law.

Since then, CSIR-CCMB has used this indigenous technique in hundreds of cases including paternity disputes, identification of missing children, identification of mutilated bodies, exchange of babies in maternity wards and cases of rape and murder, among others. These include sensational cases of the assassination of the late Prime Minister Shri Rajiv Gandhi, the assassination of the Punjab Chief Minister, the famous Tandoor murder case of Naina Sahni and the busting of the Swami Premananda scandal.

Data from DNA fingerprinting technology is considered unbiased, unfabricated and 99.9% accurate. Legal courts accept that no two individuals have the same DNA standard. Based on the success of the technology, a separate autonomous institute, 'Centre for DNA Fingerprinting and Diagnostics (CDFD)' has been set up by the Department of Biotechnology, Ministry of Science and Technology, Government of India. The Centre regularly receives samples from the investigating agencies for establishing the DNA identity of individuals. CDFD and CSIR-CCMB maintain strong bonds with court judges to explain to them how the technology works. In addition, there are about 30 other State and Central Forensic Laboratories in the country that can now do such tests.

DNA Fingerprinting has seen success in:

- Establishing paternity and maternity
- Identification of a missing child and mutilated body
- Identification of criminals in cases of rape, murder and assassination
- Immigration purposes
- Pedigree analysis of farm animals
- Assessment of inbreeding
- Plant variety identification
- Sexing of biological samples
- Wildlife forensics
- Wildlife conservation
- Biodiversity conservation

It is also important to note that the technology establishes an individual's identity by probing only a very small variable region of their DNA. This region does not lead to any information such as their medical history or ethnic background.

Future of DNA fingerprinting in India

India has used DNA fingerprinting for establishing guilt in suspects and convicts in court cases. However, the technology can be equally useful in establishing the innocence of suspects and convicts. India is yet to have made use of this technology for saving people from wrongful convictions. The Indian legal system also has very limited sections that mention DNA. Wherever it does, it only talks of the procedures and situations under which DNA samples are collected from the accused and the victim.

The Indian legal system accepts DNA fingerprinting as corroborative and not conclusive evidence yet. The biggest hindrances are the lack of regulations of sample collection and data storage, and the lack of clarity on the kind of information that the DNA fingerprinting data holds. The technology also brings fear of violation of the right of privacy, dignity, assumption of innocence, health and others. It triggers insecurities in minorities in our society. There is a discrepancy on how long the data will be available, and how it can be used by people in other cases. There have been cases of data fraudulence in the country. All of these put together, only 2-3% of legal cases in India avail DNA fingerprinting technology.



Media coverage on acceptance of DNA fingerprinting data in legal action

On the other hand, India has an estimated 40,000 unidentified bodies. About a lakh of children go missing each year. These could all benefit from the usage of DNA fingerprinting technology if the regulations are more structured. The current DNA bill in India seeks to address the quality, accuracy and security of data and related matters. It aims to establish DNA Regulatory Board that will lay guidelines, standards and procedures for the establishment and functioning of testing labs and DNA data banks. The country hopes that the bill addresses many of the current gaps so that DNA fingerprinting technology goes beyond select cases, and becomes a more regular norm in legal procedures.



Somdatta Karak & K Thangaraj
Adapted from the CSIR Blog (<https://www.csir.res.in/csirblog-success-stories>)



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High Power Magnetrons: Strengthening Strategic, Medical and Industrial Domains of India

THE design and development work on magnetron at CSIR-CEERI started since the establishment of the laboratory in the year 1953. A series of magnetrons, mostly in the S-band at different power and frequencies, have been designed, developed and delivered to the users. The device has been successfully developed by the collaborative efforts of CSIR CEERI and our sponsoring partners like the Department of Atomic Energy (DAE), Department of Electronics and Information Technology (DeitY), DRDO, BRNS (DAE) Government of India.

During 1996-2006, CSIR-CEERI designed and produced a 2 MW S-band magnetron (two versions at 2.998 GHz and 2.856 GHz) in limited numbers and delivered to RRCAT, Indore for their LINACs/Microtron program. During the same period, a glass version of 3 MW magnetron in S-band (2.998 GHz) was also developed and delivered to RRCAT, Indore. BRNS, BARC Mumbai, sponsored both the projects.



**2 MW S-band tunable
pulse magnetron**



**3 MW S-band (2.998 GHz)
tunable pulse magnetron**

LINAC-based X-ray machines are extensively used for industrial, medical and security applications. BARC, Mumbai, in association with ECIL, Hyderabad, has initiated the development of such cargo screening machines to be employed near borders. These LINAC-based X-ray machines use high-power microwave sources such as klystrons and magnetrons for the acceleration of the particles.

CSIR-CEERI has designed, developed and delivered a 3 MW S-band (2.885 GHz) pulse magnetron to BARC, Mumbai, for these applications with technical know-how.



2.6 MW magnetron at it testing in LINAC System

The frequency tuning of these magnetrons from a remote location was always a challenging problem. CSIR-CEERI has developed a PLC-based motorized tuning mechanism to tune the frequency of the magnetron from a remote location so that exposure of X-ray to the operator can be avoided.

In addition to these magnetrons, an R&D project entitled ‘Design & Development of 2.6 MW S-Band Tunable Pulse Magnetron’ was carried out at CSIR-CEERI, Pilani, sponsored by the Department of Electronics and Information Technology (DeitY), Govt. of India in collaboration with SAMEER, Mumbai during 2008-2013. The project’s scope was to design and develop a glass version water-cooled tunable magnetron with an operating frequency of 2998 MHz and minimum peak power of 2.6 MW up to the successful laboratory prototype stage. The developed magnetron was required to retrofit an existing LINAC system, thereby replacing a foreign commercial magnetron. CSIR-CEERI successfully developed and delivered these magnetrons to SAMEER, Mumbai.

The magnetron was tested on the LINAC system at SAMEER, Mumbai setup, and the required X-ray dose was achieved. Recently, the technical know-how of the 2.6 MW magnetron has been transferred to M/s Panacea Medical Technologies Pvt. Ltd., Bengaluru for mass production and use in their radiation therapy machine for cancer treatment. The successful development of 2.6 MW magnetron technology has established and strengthened the technological base and capabilities for developing higher power magnetrons in our country.

CSIR-CEERI’s know-how and research knowledge in magnetrons, with modern-day applications of magnetrons, together can bring radical advancement in industrial, medical, and strategic sectors.

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Adapted from the CSIR Blog (<https://www.csir.res.in/csirblog-success-stories>)

