

DNA Profiling in Immunogenetics: Its Role and Importance in Forensic Science and Genealogy Research

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DESCRIPTION

DNA profiling, also known as DNA fingerprinting or genetic profiling, is a revolutionary scientific technique that has transformed various fields, from forensic science to paternity testing and genealogy research. This method allows scientists to analyze an individual's unique genetic code, providing invaluable insights into their identity and relationships. DNA profiling has not only revolutionized criminal investigations but has also played a pivotal role in understanding human genetics and ancestry. In this article, we will discuss about DNA profiling, exploring its history, methodology, applications, and ethical considerations.

History of DNA profiling

The story of DNA profiling dates back to the early 1980s when British geneticist Sir Alec Jeffreys made a groundbreaking discovery. Jeffreys found that certain regions of an individual's DNA exhibited highly variable sequences, which could be used as unique genetic markers. These markers, known as Variable Number Tandem Repeats (VNTRs) or microsatellites, became the foundation of DNA profiling. Jeffreys's work led to the development of the first DNA profiling technique, called Restriction Fragment Length Polymorphism (RFLP). However, RFLP was time-consuming and required relatively large DNA samples, making it less practical for routine use. In the mid-1980s, the introduction of Polymerase Chain Reaction (PCR) technology by Kary Mullis revolutionized DNA profiling. PCR enabled scientists to amplify tiny DNA samples, making the process faster and more efficient. This breakthrough marked the beginning of the modern era of DNA profiling.

Methodology of DNA profiling

DNA profiling involves several key steps:

Sample collection: The process begins with the collection of a biological sample, which could be blood, saliva, hair, skin cells, or any other tissue containing DNA.

DNA amplification: In this step, (PCR) Polymerase Chain Reaction is used to replicate specific regions of the DNA, such as microsatellites or Short Tandem Repeats (STRs). These regions are highly variable between individuals.

Data analysis: The DNA profile is then analyzed using specialized software to determine the number of repeats at each STR locus, creating a unique genetic profile for the individual.

Applications of DNA profiling

Forensic science: DNA profiling has revolutionized criminal investigations. It is used to identify suspects, link crime scene evidence to perpetrators, and exonerate innocent individuals. DNA databases, such as (CODIS) Combined DNA Index System, store genetic profiles from convicted criminals and unsolved cases to aid in future investigations.

Paternity testing: DNA profiling is widely used to establish biological relationships, such as paternity and maternity testing. By comparing the genetic profiles of an alleged parent and child, it can confirm or refute biological relatedness.

Genealogy and ancestry: DNA profiling has opened up new possibilities for individuals interested in tracing their genealogical roots. Companies like 23andMe and AncestryDNA offer commercial DNA testing kits that allow people to explore their ancestry and discover relatives they may not have known about.

Medical diagnostics: DNA profiling is increasingly important in medical diagnostics. It can identify genetic markers associated with diseases, predict susceptibility to certain conditions, and help personalize treatment plans.

Wildlife conservation: DNA profiling is used to study and protect endangered species. By analyzing the DNA of animal populations, conservationists can monitor genetic diversity, track poaching, and devise conservation strategies.

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Ethical considerations

While DNA profiling offers numerous benefits, it also raises ethical concerns. These include issues related to privacy, consent, data security, and potential misuse of genetic information. It is crucial to establish clear guidelines and regulations to protect individuals' genetic privacy and prevent discrimination based on genetic traits.

CONCLUSION

DNA profiling is a remarkable scientific advancement that has transformed various fields, from solving crimes to

understanding our ancestry and genetic predispositions. Its evolution from RFLP to PCR-based techniques has made it faster, more accurate, and accessible. As one continues to unlock the mysteries of our genetic code, it is essential to approach DNA profiling with ethics and responsibility, ensuring that it serves the betterment of society while respecting individual rights and privacy. DNA profiling stands as a testament to human ingenuity and the profound impact science can have on our lives.