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DNA Profiling Technologies in Forensic Analysis

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ABSTRACT The remarkable advances in DNA technologies over the past two decades have had an enormous impact on human identification, medical diagnosis, population genetics, understanding of evolution of species, wildlife management, characterization and unfolding the mysteries of antiquity of archaic specimens. This article presents an overview of the current technologies in the field of forensic genetics, their evolution and the emerging trends. DNA techniques have opened a new frontier in forensic analysis. Until 1985 all polymorphic immunological and biochemical markers employed to identify biological samples in criminal cases had limited applicability. The way to a new course of events was first paved by the introduction of minisatellites using multilocus probes (MLPs), providing incomparably higher discriminatory power. However, the procedures for multilocus typing were too arduous and required very large amounts of intact DNA which were usually not recovered from the difficult forensic biological specimens. This paved way for initiation of single locus probes (SLPs) in VNTR (variable number of tandem repeats) detection analysis. The advent of the polymerase chain reaction (PCR) was the turning point in the crucial issue of analytical efficiency of the DNA variants in the genome. Since then the field of molecular identification seems to have acquired a virtual unlimited power of analysis allowing experts to address even the most inaccessible sources of DNA. The first PCR amplification based DNA technique used in human identification was the reverse dot blot assay (HLADQA1 and PM typing), which was followed by short tandem repeat (STR) PCR multiplex analysis. Ease of amplification and automation are the salient features of STR analysis. Other contemporary DNA markers and techniques in vogue in forensic investigations include Y-STRs, mtDNA polymorphisms, RAPD and analysis of sequence variation in conserved mitochondrial genes for species identification. Single nucleotide polymorphisms (SNPs) analysis using single stranded conformational polymorphisms (SSCP) and micro array techniques are innovative additions in DNA field, throwing new light into the field of human identification and population studies. A brief discussion of these technologies, overview of their applications, their merits and demerits have been provided in the paper. National and international scenario on application of DNA methods, information on quality assurance programs and DNA databases have been dealt with for better comprehension of the advantages and limitations of DNA based technologies.

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