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DNA Typing- A Method to Identify Criminals

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Review Article

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ABSTRACT

DNA typing is also called DNA fingerprinting. It is a forensic technique mainly used to identify the characteristics of individual's genome called DNA. DNA (deoxyribonucleic acid) represents the blueprint of the human genetic makeup. It exists in virtually every cell of the human body and differs in its sequence of nucleotides (molecules that make up DNA, also abbreviated as adenine (A), thymine (T), guanine (G), and cytosine (C). It is called as "fingerprint" because any two people do not have exactly the same DNA and same physical fingerprint. The human genome is made up of 3 billion nucleotides, which are 99.9% identical from one person to another person. The 0.1% variation, therefore, can be used to distinguish one individual from another. It was first developed and used in 1985. The modern process of DNA profiling was developed in 1988. It is used for parentage testing and criminal investigation, to identify a person or to place a person at a crime scene to facilitate police detective work and help clarify paternity and immigration disputes. DNA fingerprinting has also been widely used in the study of animal populations and has revolutionized the field of zoology.

INTRODUCTION

In all humans 99.9% DNA is same and the remaining DNA is mainly used to distinguish one from another [1-9]. DNA typing uses repeated sequences called variable number tandem repeats (VNTRs), and short tandem repeats (STRs) [10]. It was first developed by Professor of Genetics named Alec Jeffreys. The reference sample is DNA [11,12]. Buccal swab is used as sample used for this technique as it is easy, cheap and non-invasive. Other samples like semen, blood, saliva, body fluids, tissues, hair and other stored samples like biopsy tissue, banked sperm etc. Some of the samples are also collected from relatives who are blood related as it is the indication of the suspect profile [13-19]. The collected DNA sample is tested for genetic match [20,21].

METHODS

DNA is extracted from blood, cells, skin, hair etc and is purified by using restriction fragment length polymorphism (RFLP) technology. RFLP cuts the DNA at specific points [22-24]. Later the restricted fragments along with some

detergents and identification markers called biomarkers are placed in a gel to run the electrophoresis. By applying electric current the shorter fragments, move more quickly towards the positive pole (anode) [25-27]. Then the double stranded DNA containing gel is placed for blotting technique to get single strands and then they are transferred on to a nylon sheet. DNA fragments were auto radiographed and exposed to DNA probes [28-30]. To the fragments a piece of X-ray film was then exposed and a dark mark was produced at any point where a radioactive probe had been attached. The resulted pattern of marks could be analyzed later [31].

Restriction Fragment Length Polymorphism (RFLP)

After digestion of DNA samples with specific restriction endonucleases different lengths of DNA fragments are obtained which are homologous sequences [32-34]. RFLP is a molecular marker to specific a single clone/restriction enzyme [35,36]. The DNA samples are digested in to one or more fragments and a probe is labeled to hybridize and then they are separated by using gel electrophoresis. At a specific locus a unique blotting patter is characterized to specific genotype [37-44]. In RFLP propped we use single or low copy number genomic clones, cDNA clones, short sequences. This method is mainly used for hereditary disease diagnosis, genotyping, variation analysis, genome mapping, forensics, paternity tests etc [45-54].

PCR (Polymerase Chain Reaction)

Kary Mullis in 1980 developed this chain reaction. PCR is mainly based on polymerization reaction in which it synthesis the new strands of DNA according to template strands of DNA by using DNA polymerase enzyme [55-57]. As DNA polymerase is an enzyme which adds complementary nucleotides only on preexisting 3'-OH group and to add a first nucleotide it needs a primer which is only presented on 3'-OH group side of the DNA strand. This method is useful to delineate a specific region of template sequence which is required to researcher. A billion of copies called amplicons are produced at the end of the PCR reaction [58-60].

STR (Short Tandem Repeats) Analysis

STRs are DNA markers that are easily amplified by polymerase chain reaction. For STRs the PCR products are similar in amount, making analysis easier [60-64]. From each parent the individual inherits one copy of an STR in which the repeat sizes may or may not similar [65]. Among individuals the STR markers are variable in the number of repeats which make them effective for purpose of human identification [66].

AmpFLP (Amplified Fragment Length Polymorphism)

In genetics research AFLP-PCR is used as PCR-based tool in genetic engineering practices [67,68]. This method is developed in 1990s by Keygene, as it uses restriction enzymes to digest genomic DNA, ligation of adaptors to the sticky ends [69]. This methods takes place in three steps: by using restriction enzymes the cellular DNA is get digested and specific adaptors are restricted for ligation. Some of these fragments have two PCR primers that are restriction site specific sequences and corresponding adaptor for selective amplification [70-72].The bands are visualized by electrophoresis separation by using amplicons on a gel matrix [73]. This technique is mainly used to detect transposable element mobility, TE Display, quantify differences in gene expression levels etc [74-77].

DNA Family Relationship Analysis

DNA testing has revolutionized the family relationship testing industry and paternity among individuals with a higher power of discrimination and non-invasive sample collection options. In this method we will find the information about the DNA properties which are specially used for paternity testing and results of interpretation [78,79].

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Y-Chromosome Analysis

Y chromosome analysis is a useful technique for DNA analysing that are likened in one sense to studying male surnames [80]. As the male surnames are passed from one generation to the other generations by the sons. Y chromosomes is simply represented in this technique. From his biological father a son inherits a Y chromosome and an X chromosome he inherits from his biological mother. In the same way female also inherit an X chromosome from her biological father and an X chromosome from her biological mother.This method is used for DNA analysis as it has important ramifications for scientists wishing to investigate the familial ties between male members.

Mitochondrial Analysis

Mitochondrial DNA analysis is a somewhat different type of DNA analysis compared to other techniques used today [81]. It generally works well on samples that are unable to be analysed through numerous other techniques. To understand how mitochondrial DNA analysis works, however, it is important to have a sense of how a cell is structured.

Advantages

- Identify paternity and Criminal cases evidences [82].
- Identify people.
- For diseases predisposition determination [83].
- To determine biological relationships.
- To determine a reasonable doubt, whether that person is in criminal activity [84].
- To determine the likely-hood that an individual will contract certain diseases or cancers [85].
- Used to identify dead bodies that can't be recognized in any other ways
- Conclusive fairly.
- It is a painless and easy method.
- It is less invasive by taking a blood sample [86].
- A reliable and an affordable technique [87].
- Less time taking.
- This method is used in any age and anyone can be diagnosed.
- There is a large variety of uses such as in prenatal testing, identification for the military, missing person's cases, legal claims and paternity [88].
- In agriculture it is used for variety identification—whether the seed is really from the variety being original and to detect genetically modified organisms in agriculture which are utilized in genetic profiling [89,90].
- To find genetic relatedness, markers have been used for determination of genetic diversity of tea and characterization. Also used alternative medicine and herbal preparations as there are some medical uses related to some of these plants [91].
- It can be used to help identify, parentage testing and breed thoroughbred horses [92,93].

Disadvantages

- It is better providing familial relationships which would take more work than two siblings were being accused of parenting the same child.

•DNA evidence is much useful in criminal cases, and the evidence only helps prove that an individual was present at a certain location, not exactly when or what they were up to [94-96].

•DNA fingerprinting is costly and consumes more time and it is not very useful for everyday identification uses. Fingerprints are more useful and easier to store [97].

•We accept it as accurate, though, because perhaps the chances of error are 1 in 40 billion which depends on the quality of the sample, it may be something like 1 in 4

•The sample of DNA can easily be ruined during the process of DNA fingerprinting, causing the sample to become completely useless for testing [98].

•The test needs to be analyzed on many samples for ideal accuracy. Usually, laboratory runs each test twice with four samples [99].

•Privacy issues could occur if the information isn't kept secure at the lab. Personal information legally can only be released with a written order. This personal information if leaked, could potentially complicate insurance processes, health care and job prospects for an individual [100].

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