**DNA fingerprinting in Medical Biotechnology**

DNA fingerprinting is a molecular genetic method that enables the identification of individuals using hair, blood, or other biological fluids or samples. This is able to be accomplished due to unique patterns (polymorphisms) in their DNA. It is also known as genetic fingerprinting, DNA typing, and DNA profiling.

When used for forensic science, DNA fingerprinting makes use of probes that target regions of DNA specific to humans, thus eliminating any possibility of contamination by extraneous DNA from bacteria, plants, insects, or other sources.

**The Different Methods Used**

When first described in 1984 by British scientist Alec Jeffreys, the technique focused on sequences of DNA called mini-satellites that contained repeating patterns with no known function. These sequences are unique to each individual, with the exception of identical twins.

Different DNA fingerprinting methods exist, using either restriction fragment length polymorphism (RFLP), polymerase chain reaction (PCR), or both.

Each method targets different repeating polymorphic regions of DNA, including single nucleotide polymorphisms (SNPs) and short tandem repeats (STRs). The odds of identifying an individual correctly depends on the number of repeating sequences tested and their size.

**How DNA Fingerprinting Is Done**

For human testing, subjects typically are asked for a DNA sample, which can be supplied as a blood sample or as a swab of tissue from inside the mouth. Neither method is more or less accurate than the other, according to the DNA Diagnostics Center.

Patients often prefer mouth swabs because the method is less invasive, but it has a few drawbacks. If samples are not stored quickly and properly, bacteria can attack the cells containing DNA, reducing the accuracy of the results. Another issue is that cells are not visible, so there is no guarantee that DNA will be present after a swab.

Once collected, the samples are processed to extract the DNA, which is then augmented using one of the methods described previously (PCR, RFLP). The DNA is replicated, amplified, cut and separated through these (and other) processes to achieve a more thorough profile (fingerprint) to compare to the other samples.

**Fields Where DNA Fingerprinting Is Beneficial**

Genetic fingerprinting can be used in criminal forensic investigations. A very small quantity of DNA is reliable enough in identifying individuals involved in a crime. Similarly, DNA fingerprinting can and does exonerate innocent people of crimes—sometimes even crimes committed years ago. DNA fingerprinting can also be used to identify a decomposing body.

DNA fingerprinting can answer the question of the relationship to another person quickly and accurately. In addition to adopted children finding their birth parents or settling paternity suits, DNA fingerprinting has been used to establish a relationship in cases of inheritance.

DNA fingerprinting serves several uses in medicine. One important instance is identifying good genetic matches for organ or marrow donation. Doctors are beginning to use DNA fingerprinting as a tool for designing personalized medical treatments for cancer patients. Moreover, the process has been used to ensure that a tissue sample has been correctly labeled with the patient's name.

DNA fingerprinting is based on the distribution of small repetitive elements called "minisatellites" that are contained in the cellular DNA, or deoxyribonucleic acid, of an organism. The technique is also known as DNA profiling, DNA typing or genetic fingerprinting. Since each cell of an organism contains the same DNA, the technique can be used to identify individuals. Several techniques are available to visualize the distribution pattern of mini-satellites with applications in genetic research, paternity testing, family genealogy, agriculture and forensic genetics for crime investigation.

In 1984, Alec Jeffreys, a British geneticist, identified the presence of minisatellites within the boundaries of genes. These minisatellites do not contribute to the functioning of genes and are distributed throughout the cellular DNA of an organism in a unique and inheritable pattern. The DNA fingerprint can be revealed by processing cells collected from individuals through one of several different techniques. These different techniques for genetic fingerprinting have been applied to identify and isolate disease genes, develop cures for diseased genes, and diagnose genetic diseases.

**Paternity Testing**

Testing paternity samples requires the collection of cells and comparison of DNA fingerprints from and between children and potential parents. Children will have a mix of DNA fingerprints inherited from each parent. When a child is conceived, each parent provides half of the genetic information. Most often the test is performed when the mother of the child is known but the father is in question. Since it is highly unlikely that any two people will have the same genetic fingerprint, paternity testing using DNA fingerprints is a reliable way to determine the parentage of a child.

A crime scene can contain biological samples, including blood, semen, saliva, skin, urine and hair, from perpetrators, victims and bystanders that can be processed to provide DNA fingerprints. The DNA fingerprints obtained are used to search existing databases for matches and to identify victims or suspects. The biological evidence and the DNA fingerprints can be used in trials to help prove guilt or innocence. The United States military has been storing DNA fingerprints of all military personnel for identification of casualties and those missing in action. The military has found the technology to be superior to identification methods used previously.

**Plants and Animals**

DNA fingerprinting of plants and animals is performed for food security, food safety, identification and parentage. In food animals, DNA fingerprinting can be used to trace meat to the source animal. The technique can be used to identify endangered and non-endangered fish species, while the sources of plants can be verified to prevent counterfeiting of seeds and stock. Pathogenic food organisms can be quickly identified by their DNA fingerprints, allowing doctors to provide timely, targeted treatment.