DNA-Profiling

Ashutosh Abhangi
"Aryan", Gopalwadi-4,
Nr.Trimurti school, Junagadh

Nikunj Kariya
104, Takshashila apartment,
Nehru park society, Junagadh

Vaseem Ghada
B.H.Gardi College of Engg & Technology – Rajkot.

ABSTRACT
DNA is chemical as well as biological identity or description of human body which is found in everyone's cell which is unique for every individual accept identical twins. DNA is a structure that encodes the genetic instructions used in the development and functioning of all living organisms. DNA is combination of four different chemical compounds (adenine, guanine, cytosine, and thymine) that appear in pairs known as base pairs. Humans have 23 pairs of chromosomes, with two sex chromosomes which decide gender and 22 pairs of chromosomes that dictate other factors. [2,3]

DNA Profiling is process which is performed by forensic experts to portrayal DNA in encrypted sets of letters that reflects person's DNA makeup, which can be also used as the individual's identifier. DNA Profiling is used in paternal examination, criminal investigations and also used in genetic engineering. From DNA only that information can be stored into database which is not used to identify any type of mental or physical trait, tendency and disease. [3]

Keywords
DNA extracting ; Short Tandem Repeat; DNA Analysis; Genetic Testing; RFLP; DNA Fingerprinting; DNA; Profiling; Forensic Science.

1. INTRODUCTION
DNA deoxyribonucleic acid is found in every cell with a nucleus in all living organisms. DNA is a complex molecule structure that contains all of the information necessary to build and also to maintain an organism. All living things have DNA within cells. [1]

DNA is the chemical structure which describes our behaviour, appearance and genealogy and is unique for everyone except monozygotic twins. DNA is basically a long molecule that contains coded instructions for the cells. Everything the cells do is coded in DNA - which cells should grow and when and, which time cells should die and when, which cells should make hair and what colour it should be. DNA is only the reason behind our skin colour, hair colour, some specific dots or inherited sign. Our DNA is inherited from our parents. Our DNA reflects image. [2]

We may resemble our parents, but we can't be the same. Because each we inherited only some of the DNA from each parent carries. Nearly half our DNA comes from our mummy, and half comes from daddy. The pieces we get are basically random, and each sibling gets different subset of the parents' DNA Equations.

2. STRUCTURE OF DNA
Deoxyribonucleic Acid or DNA is the molecule of Human body. Our functions, habits, inherited sign or habits can be identifying by the DNA. The DNA molecule having structure like large ladder in which vertical pieces contain of alternating sugar molecules and phosphate groups, and the rungs are complementary bases. DNA structure can be divided in to four levels: Primary, secondary, tertiary and quaternary. [4, 5]

Primary Structure contains linear sequence of nucleotides that are linked together by phosphodiester bonds. This linear sequence of nucleotides makes up the primary structure of

DNA or RNA. The nucleotides consist of main 3 components

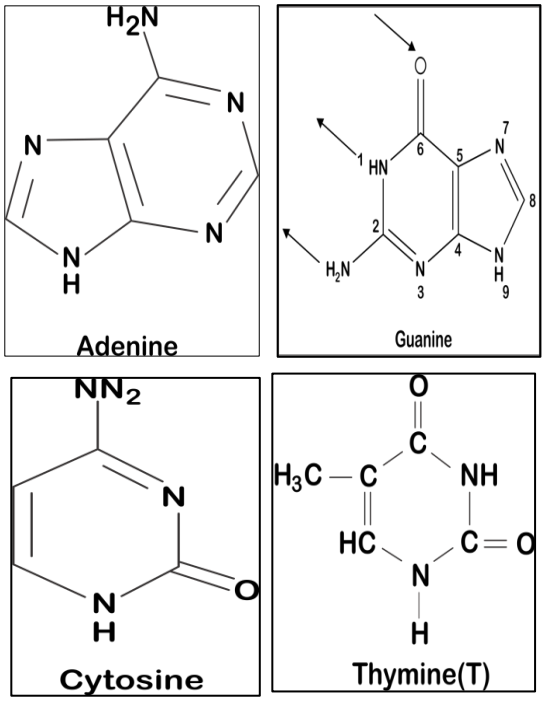

Fig 1: (a) Adenine (b) Guanine (c) Cytosine (d) Thymine

The nitrogen bases adenine and guanine purine in structure from a glycosidic bond between their 9'nitrogen and the 1'OH group of the deoxyribose. In older times adenine is also called as vitamin B4. It was not consider as B4 as long time as it consists of NAD (Nicotinamide Adenine Dinucleotide) and FAD (Flavin Adenine Dinucleotide) respectively. In 1885 by Albrecht Kossel replace the name B4 by Adenine (as specific gland in Greek-Aden). [3] Adenine forms several tautomer, components like Nucleon base with various roles in biochemistry which includes cellular respiration in the form of the energy like ATP (Adenosine triphosphate), NAD (Nicotinamide adenine Dinucleotide), FAD (Flavin Adenine Dinucleotide) and protein synthesis as a chemical component of DNA or RNA.

One of the main components found in nucleic is Guanine. It is paired with cytosine. Guanine can be representing in chemical formula as C5H5N5O. Guanine nucleoside is called guanosine. Guanine having the c-6 carbonyl group which acts as the hydrogen bond acceptor, whereas N-1 and the amino group at c-2 acts as the hydrogen bond donors. [5]

Cytosine is a pyrimidine derivative with heterocyclic aromatic ring and two substituents attached an amine group at position 4 and keto at position 2. Cytosine is the nucleoside of cytosine. Cytosine is paired with guanine. It is inherently unstable, and can change into uracil. Cytosine includes methylated into 5-methyl cytosine by an enzyme which is known as DNA methyl transfers or it can be methylated and hydroxylase to make 5 – methyl cytosine. [2, 3]

Thymine is also known as 5 – methyl pyrimidine Thymine, name itself shows that it is derived from methylation of uracil at the 5th carbon. Thymine creates the nucleoside deoxythymidine, which is similar with the term thymidine. Thymine creates this with the combination of deoxyribose. Thymine is very useful for human body. In the treatment of cancer thymine is on target in actions of 5-fluorouracil (5FU). Thymine is also represented in chemical format C5H6N2O. [2]

Secondary structure is the set of interconnection between bases i.e. part of primary bound to each other. As DNA consists of helix structure the two standards of DNA are hold to gather. Mainly secondary structure is responsible for the shape of nucleic acid. Secondary structure is having two classifications: (i) purines (ii) pyrimidine. [2]

In which purines contains adenine and guanine whereas pyrimidine contains cytosine and thymine. Secondary structure is predominantly determined by base of pairing of the two polynucleotide standards wrapped into each other to from a double helix. Here both are major and minor groove on double helix co-responding. [4]

Tertiary structure is located of the atoms in three dimensional spaces which consider the geometrical and steric constraints. Tertiary structure is higher structure than secondary structure. In entire chain is folded into a specific 3- dimensional shape.

Tertiary arrangement of DNA's double helix in space includes B-DNA, A-DNA, and Z-DNA. B-DNA is most common for A-DNA and become larger helix than type A. A-DNA is shorter but wider than helix B. Z-DNA is relatively rare left handed double helix. [4]

Quaternary structure is based on nucleic acids. It is similar to protein quaternary structure. Some of its part is not completely same but it refers to a higher level construction of nucleic acids.

3. WORKING OF DNA PROFILING

DNA profiling is also called DNA finger printing, DNA testing. DNA typing or DNA genetic finger printing is a technique use by forensic scientists to distinguish between individual of the same species using samples of their DNA. It was invented by Alec John Jeffrey in 1985. To identify the children and to find out the criminal DNA profiling is very useful. [6]

It contains following steps:

3.1 Collect a sample and extract it DNA

DNA can easily found in every human cell. For the forensic purpose scientist collect the hair sample, blood sample or inner cheek cells. After collecting the sample chemical added to extract DNA and to isolate it from other components.

3.2 Amplify the tell-tale regions

Scientist use very effective technique name Polymerase Chain Reaction (PCR). [10, 11] It is use to make millions of copy of DNA sample. In particular, their regions known as Short Tandem Repeats(STR), which are composed of short units of DNA, that are repeated numerous times in a row. These STR numbers are various from person to person. So, it's easy to identify the person. [10, 11]

3.3 Count the repeats

It is hard to identify from a sample copy. So scientist will generate the copies of STR and run the mixture through a capillary electrophoresis machine, which separates the various DNA fragments by size. STR size is very important. The number of times a nucleotide sequence is repeated in each STR can be calculated from the size of the STRs. A forensic scientist can use this information to identify the person from this sample. [6, 8]

3.4 Look for a match

His/hers STR repeats must match to another sample of DNA.
I.e. in criminal cases According to FBI if all 13-STR matches than it means that you catch your criminal.

DNA Profiling Techniques

3.5 RFLP

In RFLP In molecular biology, restriction fragment length polymorphism, or RFLP, is a process that exploits variations in homologous DNA sequences.[1,2] It reflects a difference between samples of homologous DNA molecules that come from differing locations of restriction enzyme sites, and to a related laboratory process by which these segments can be illustrated. In RFLP analysis, the DNA sample is broken into pieces (digested) by restriction enzymes and the resulting restriction fragments are separated according to their lengths by gel electrophoresis.[13] Now a day RFLP analysis is not in too much use to other inexpensive technologies but RFLP was the first DNA profiling technique enough to see widespread application. [13]

RFLP analysis was an important tool for genome mapping; locate of genes for genetic disorders, determination of risk for disease as well as paternity testing. [6]

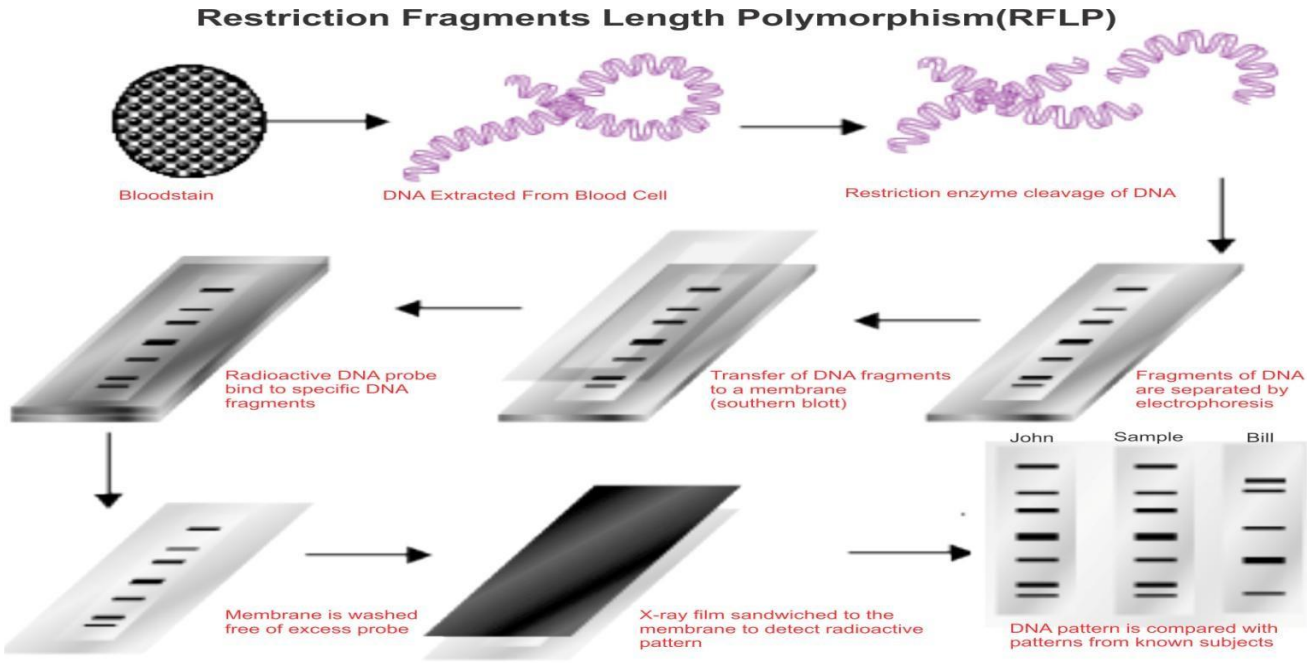

Fig 2: RFLP technique

3.6 STR

Short tandem repeat (STR) analysis is currently in use technology for DNA Profiling. It is a molecular biological method employed to compare particular loci on DNA from multiple samples.[1,2] A short tandem repeat is a microsatellite, containing a unit of two to thirteen nucleotides repeated hundreds of times in a row on the DNA strand. [1]

Through STR analysis one can measures the exact number of repeating units. It differs from restriction fragment length polymorphism analysis (RFLP) in a way that STR analysis does not cut the DNA with restriction enzymes. Instead of enzymes, probes are attached at specific regions on the DNA, and a polymerase chain reaction (PCR) is executed to discover the lengths of the short tandem repeats. [6, 11]

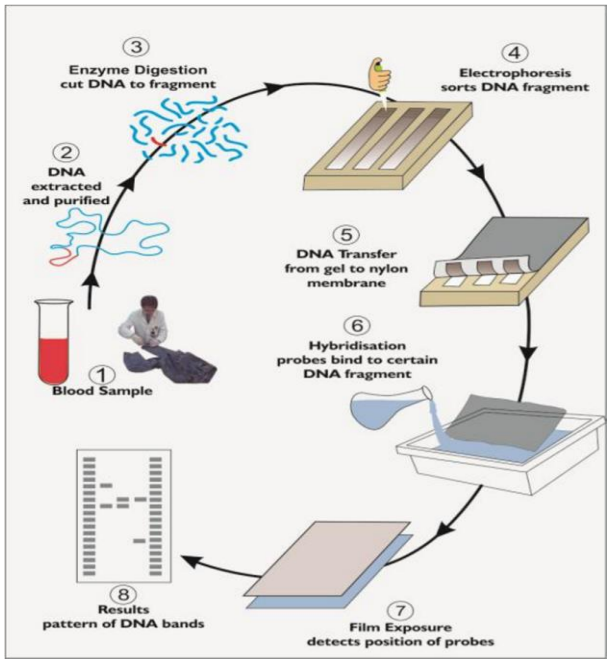

Fig 3: DNA Profiling Process

4. USE OF DNA PROFILING

There are some of the uses of DNA Profiling:

4.1 Paternity Testing

is the use of genetic fingerprinting to determine whether two individuals have biological parent child relationship or not? [9, 10]

4.2 Immigration

in some case to take visa we have to established relationship to our relatives at that time we need DNA Profiling. [9]

4.3 Criminal cases

To solve some criminal cases we need DNA Profiling and there are some cases which are very complex that can be solved by DNA Profiling. [7, 9]

5. CONCLUSION

Here we are concluding that the future scope of DNA profiling process and its comparison process can be improved by increasing number of STR values and we can get more accurate result than traditional DNA-profiling process. Further we can modify chemical process with help of structural generating language like bio-java. The requirement and demand of fast and efficient DNA Profiling process is very high Due to natural disasters and rape cases.

6. ACKNOWLEDGMENTS

We would like to thanks the Department of Computer Science & Engineering of B.H. Gardi College of Engineering and Technology, Gardi Vidhyapith Campus, Kalawad Highway, Opp. Hotel Shiv Shakti, Village – Anandpar 361162, Gujarat, India and also thanks to the Forensic Science Laboratory (FSL) sector 18-A, Near police bhavan, gandhinagar-382010, Gujarat , India.

7. REFERENCES

[1] Edwards A, Citivello A, Hammond HA and Caskey CT (1991) DNA typing and genetic mapping with trimetric and tetramer repeats Am J Hum Gen 49: 746-756.

[2] Gill P, Ivanov PL, Kimpton C, Piercy R, Benson N, Tully G, Evett I, and Hagelberg E (1994) Identification of the remains of the Romanov family by DNA analysis Nature genetics 6:130-135.

[3] Jeffreys AJ, Wilson V, Thein SL (1985) Individual specific "fingerprints" of human DNA Nature 316:76-79.

[4] Locard E L'enquete criminelle ET les methodes scientifiques, Paris 1920.

[5] Sullivan KM, Pope S, Gill P, Robertson JM (1992) Automated DNA profiling by fluorescent labelling of PCR products PCR Methods and Applications 2: 34-40.

[6] Sherif H. EI-Alfy, Ahmed F. Abd EI-Hafez from Journal of Genetic Engineering and Biotechnology (2012)10, 101112. Paternity testing and forensic DNA typing by multiplex STR analysis using ABI PRISM 310 Genetic Analyzer.

[7] H.M. Wallace, A.R. Jackson, J. Gruber, A.D. Thibedeau. Forensic DNA databases:Ethical and legal standards: A global review.

[8] Ajay Balayan, Abhilasha Kapoor, Garima Chaudhary, Anupuma Raina. Evaluation of techniques for human bone decalcification and amplification using sixteen STR markers.

[9] Yuk-Ka Chung, Wing K. Fung , Yue-Qing Hu. Familial database search on two- person mixture.

[10] Retrospective study of the impact of miniSTRs on forensic DNA profiling to touch DNA sample by Filip Van Nieuwerburgh, David Van Hoofstat, Christophe Van Neste, Dieter Deforce- SCIJUS-00452

[11] Developmental validation of the PowerPlex 18D System, A rapid STR multiplexor analysis of refrence samples by Kathryn Oostdik,Julie French,Donald Yet,Briana Smalling,Craig Nodle,Peter M. Vallone,Erica L.R.Butts and Team from Forensic Science International : Genetics 7(2013) 129-135.