



Session 167: Applications of PCR technology

Dr. Raghu Gogada

Principles and Applications of PCR Technology:

As a biochemical technology, polymerase chain reaction (PCR) is widely used for varied applications across the field of molecular biology.

PCR technology, as it is popularly known, was developed in the year 1983 and since then till now, it has proved to be an indispensable technique used for numerous medical and biological applications.

What is PCR?

PCR is a biochemical technology that is widely used in the field of molecular biology for amplification of a single or few replicas of a piece of DNA across numerous structures of significance.

The technology hence helps to produce innumerable copies of a specific DNA sequence and is used in medical and biological research labs for various applications.

The contribution of PCR technology in the realm of DNA and gene related studies, analysis of diseases, and other diagnostic assessments are immense.

How PCR Technology Works?

The process of PCR technology requires unraveling the DNA structure and to form enzymatic replication of the same, and this is achieved with the help of thermal cycling.

It is a method of repetitive heating and cooling of the reaction to bring out desired results out of the DNA sequence.

This selective and repeated amplification is facilitated by short DNA fragments (primers) and a DNA polymerase.

The copy of DNA generated as the PCR progresses, acts like a template for further replication of DNA sequence.

It sets a chain reaction in motion, with an ascending amplification of DNA template.

PCR technology is widely used and modified to execute a wide array of genetic manipulations.

What are the applications of PCR technology in varied fields?

PCR technology is extensively used in numerous applications, some of which are mentioned below:

Medical Applications

- 1.The most common medical application of PCR is for genetic testing where a DNA sample is analyzed for the presence of genetic disease mutations.
- 2.Prospective parents who act as genetic carriers are tested against the presence of any disease-causing genes by using PCR technique.
- 3.The technique has proved to be useful for pre-implantation genetic diagnosis where a developing embryo's cells are tested against any mutations.
- 4.PCR is equally helpful for a sensitive test for tissue typing that is crucial to organ transplantation.

Infectious Disease Application:

- ✓ PCR technology has revolutionized the way infectious disease organisms are characterized and detected in human body, which in turn has helped medical sciences to provide immediate solution for a specific infection.
- ✓ PCR helps in varied applications dealing with infectious diseases through means like: detecting infections earlier, screening the donated blood directly for the virus, testing of the newborns against any existing virus and immediate quantifying of the effects of any therapy.
- ✓ PCR technique facilitates detailed genetic analysis to detect any resistance to antibiotic or other therapeutic methods, so that immediate and effective medical remedy can be provided against any infection.
- ✓ Besides, PCR technology is also capable of monitoring the spread of any infectious disease through an infected domestic or wild animal; so that necessary control measures can be taken on time.

Forensic Applications:

- ✓ PCR technology has proved to be equally crucial in forensic applications like genetic fingerprinting done with the help of extraction of minute DNA samples from the crime scene.
- ✓ This has greatly helped the judicial system of a country in identifying the criminal from suspects. A DNA database of earlier convicts or evidence helps in the process.
- ✓ PCR technology-based DNA fingerprinting is also used in cases where parental testing is required.
- ✓ The same process is also used to confirm the blood or genetic relationship between a concerned child and his biological parents.
- ✓ Apart from these, PCR technology is highly important in conducting research studies in the field of molecular genetics.
- ✓ Some of the research applications facilitated by this technique are hybridization probes, DNA cloning, gene expression, phylogenic analysis, sequence-tagged sites, genetic mapping and DNA sequencing.
- ✓ Recently human genome was completely sequenced opening the door for identifying hundreds of targets for therapeutic intervention for diseases such as cancer, diabetes, arthritis etc. PCR technology was very instrumental in this major milestone in biological research.