Journal of Bioengineering and Bioelectronics

Open access Commentary

Bioengineering Breakthroughs: The Convergence of Technology and Life Sciences

Asy Byatt[*]

Department of Bioengineering, University of British Columbia, Canada

DESCRIPTION

Polymerase Chain Reaction (PCR) stands as one of the most transformative techniques in molecular biology, revolutionizing the way scientists approach DNA analysis and manipulation. Developed by Kary Mullis in 1983, PCR enables the rapid and precise amplification of specific DNA sequences from minimal samples. This technique has become indispensable across various fields, including medicine, forensic science, and environmental research. By generating millions of copies of a target DNA segment, PCR has paved the way for breakthroughs in genetic research, disease diagnosis, and more. PCR is based on the fundamental principles of DNA replication, but it is performed in a controlled laboratory environment. The original DNA sample containing the sequence of interest. An enzyme that synthesizes new DNA strands. The most commonly used enzyme is Taq polymerase, derived from the thermophile bacterium Thermus aquaticus, which is stable at high temperatures. Short nucleotide sequences that are complementary to the regions flanking the target DNA sequence. Two primers are used, one for each strand of the DNA. The building blocks of DNA, including deoxyadenosine triphosphate, deoxycytidine triphosphate, deoxyguanosine triphosphate, and deoxythymidine triphosphate provides the optimal environment for the PCR reaction, including the correct pH and salt conditions. The PCR process involves three primary stages, repeated for 20-40 cycles. The reaction mixture is heated to approximately 94°C-98°C, causing the double-stranded DNA to separate into single strands by breaking the hydrogen bonds between them. The temperature is lowered to 50°C-65°C, allowing the primers to bind to their complementary sequences on the single-stranded DNA templates. The temperature is raised to around 72°C, the optimal temperature for Taq polymerase, which extends the primers by synthesizing new DNA strands complementary to the template strands. These cycles result in the exponential amplification of the target DNA sequence. After the amplification is complete, the PCR products can be analysed using techniques such as gel electrophoresis to verify the presence and size of the target DNA fragment. Polymerase Chain Reaction has profoundly transformed molecular biology by enabling the rapid and specific amplification of DNA. The technique is predicated on three key stages are denaturation, annealing, and extension. During denaturation, the DNA sample is heated to separate its double strands. In the subsequent annealing phase, short, complementary sequences known as primers bind to the target DNA regions. The final extension phase involves the Taq polymerase enzyme, which synthesizes new DNA strands by adding nucleotides to the primers. PCR's precision allows researchers to generate millions of copies of a particular DNA segment from minute quantities of starting material. This capability is crucial for applications ranging from identifying genetic mutations and detecting pathogens in clinical diagnostics to enabling forensic scientists to analyse crime scene evidence and allowing researchers to explore genetic diversity in various organisms. PCR's adaptability has also led to the development of numerous variations, such as quantitative PCR (qPCR) for measuring gene expression levels and reverse-transcription PCR (RT-PCR) for studying RNA.PCR has fundamentally transformed molecular biology by providing a powerful tool for amplifying specific DNA sequences with remarkable precision and speed. Its applications are vast, ranging from medical diagnostics where it is used to detect genetic disorders and pathogens to forensic science, where it helps identify individuals from minute biological samples. Additionally, PCR plays a critical role in genetic research, environmental monitoring, and agricultural advancements.

ACKNOWLEDGEMENT

None.

CONFLICT OF INTEREST

The author declares there is no conflict of interest.

Received:	02-September-2024	**Manuscript No:**	JBTC-24-21505
Editor assigned:	04-September-2024	**PreQC No:**	JBTC-24-21505 (PQ)
Reviewed:	18-September-2024	**QC No:**	JBTC-24-21505
Revised:	23-September-2024	**Manuscript No:**	JBTC-24-21505 (R)
Published:	30-September-2024	**DOI:**	10.35841/JBTC.06.3.22

Corresponding author Asy Byatt, Department of Bioengineering, University of British Columbia, Canada, E-mail: byatt@21.ca.com

Citation Byatt A (2024) Bioengineering Breakthroughs: The Convergence of Technology and Life Sciences. Bio Eng Bio Electron. 6:22.