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RECOMBINANT DNA PRODUCTION AND ITS IMPORTANCE IN MODERN BIOMEDICINE

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Annotation: This article analyzes the theoretical foundations of recombinant DNA technology, as well as the main enzymes and vector systems used in genetic engineering. It also highlights the role of recombinant DNA technology in pharmaceuticals, agriculture, and gene therapy, along with recent advances in this field.

Keywords: Recombinant DNA, restriction enzyme, plasmid, restriction site, electrophoresis, vector, genetic engineering, insulin, biotechnology, transgenic animals.

INTRODUCTION:

The artificial production of recombinant DNA and gene cloning were first accomplished in 1972 by American scientists Herbert Boyer and Stanley Cohen. The scientists isolated the chromosomal DNA and plasmid of Escherichia coli (E. coli) into separate containers and treated them with the restriction enzyme EcoRI, which cuts DNA to produce sticky ends. Since the bacterial plasmid contained only one restriction site recognized by EcoRI—a specific nucleotide sequence—the plasmid was linearized after digestion. In chromosomal DNA, the number of fragments produced depends on how many recognition sequences for the restriction enzyme are present; the more sites available, the more fragments are generated.

The DNA fragments were separated according to their size using gel electrophoresis under a strong electric field and then stained with dyes. The desired DNA fragment could be extracted from the gel by dissolving it in solution.

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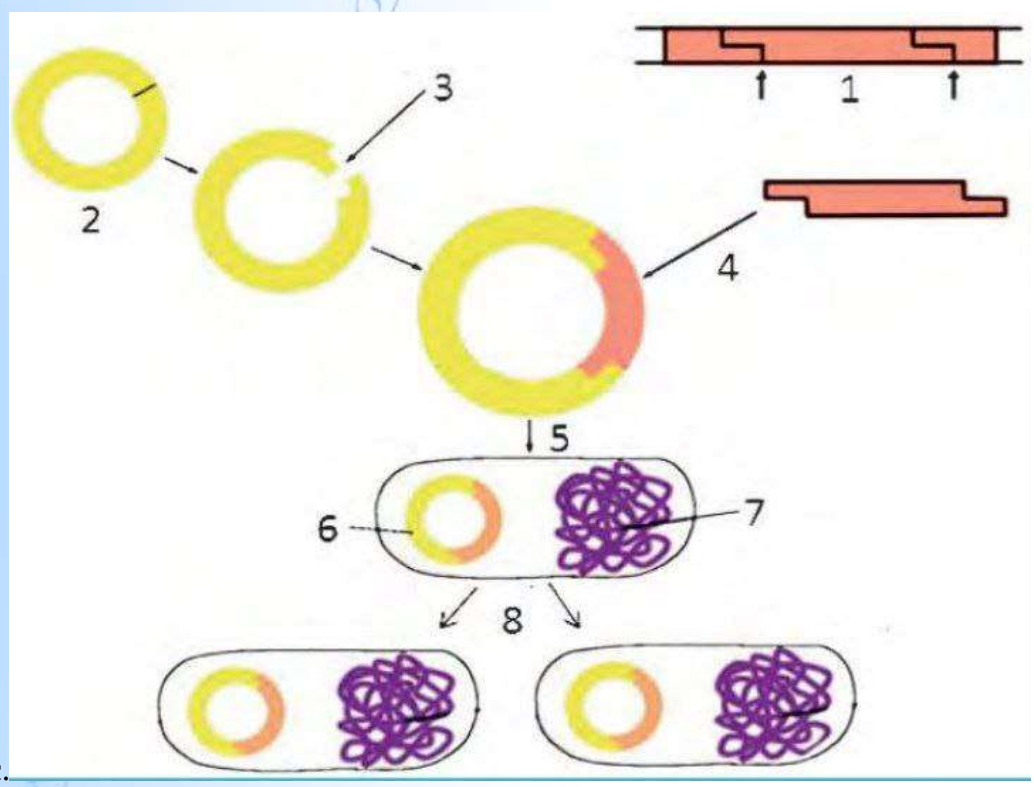
The open plasmid DNA with sticky ends was then combined in a test tube with the chromosomal gene fragment and joined together using DNA ligase, an enzyme that links DNA molecules. As a result, a recombinant plasmid was formed. In this construct, the plasmid functions as a vector, serving as a carrier that enables chromosomal DNA to be transferred into another bacterial cell via the plasmid.

For this reason, when antibiotic-resistant and antibiotic-sensitive bacterial strains are mixed, the plasmid-mediated gene transfer can result in all bacteria becoming resistant to the antibiotic.



Transgenic Plant:

By taking advantage of the unique properties of plasmids, scientists have also developed transgenic plants. In this process, they used the T-DNA region of the Ti plasmid from Agrobacterium tumefaciens. As a vector, they selected the pBR322 plasmid, since the Ti plasmid is relatively large and inconvenient for use in genetic engineering.

The T-DNA region was isolated from the Ti plasmid of the soil bacterium using a specific restriction enzyme and then inserted into the pBR322 plasmid. This structure is called a vector construct. The T-DNA region within the vector construct is cut, and a foreign gene of interest is inserted into it. As a result, the T-DNA loses its tumor-inducing ability.The resulting recombinant structure is introduced into plasmid-free strains of Agrobacterium. When plant cells are infected with such bacteria, Agrobacterium transfers the foreign gene into the plant

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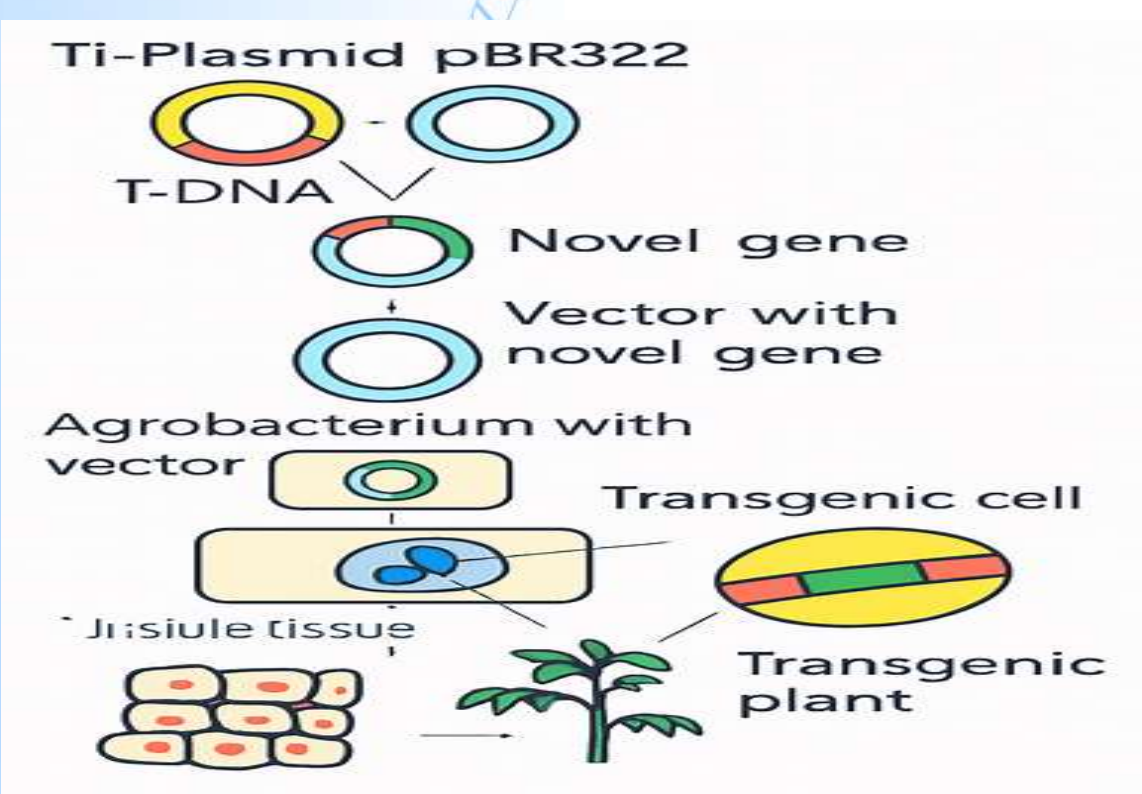
genome using its specialized transformation system. From the genetically transformed plant cell, transgenic plant is regenerated.



Note:

If the recipient DNA is treated with a specific restriction enzyme, the desired gene from the donor DNA must also be cut with the same enzyme. This is because restriction enzymes cut DNA molecules to produce either sticky ends or blunt ends, and compatible ends are required for successful ligation.

Importance of Recombinant DNA Technology

• Medicine and pharmaceuticals: Production of therapeutic proteins such as insulin and vaccines against diseases like hepatitis B.

• Agriculture: Development of transgenic plants that are resistant to pests and environmental stresses.

• Gene therapy: Treatment of genetic disorders by replacing defective genes with healthy ones.

CONCLUSION

Recombinant DNA technology is one of the most powerful methods in modern biology. It plays a crucial role not only in fundamental research but also in global food security and

medical diagnostics. In the future, this technology is expected to expand the possibilities of treating cancer and other previously incurable diseases at the genetic level.

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