

Notes -BIOTECHNOLOGY : PRINCIPLES AND PROCESSES

Biotechnology deals with techniques of using live organisms or enzymes from organisms to produce products and processes useful to humans. In this sense, making curd, bread or wine, which are all microbe-mediated processes, could also be thought as a form of biotechnology. However, it is used in a restricted sense today, to refer to such of those processes which use genetically modified organisms to achieve the same on a larger scale. Further, many other processes/techniques are also included under biotechnology. For example, in vitro fertilisation leading to a 'test-tube' baby, synthesizing a gene and using it, developing a DNA vaccine or correcting a defective gene, are all part of biotechnology.

- ✓ **Genetic engineering** : Techniques to alter the chemistry of genetic material (DNA and RNA), to introduce these into host organisms and thus change the phenotype of the host organism.
- ✓ **Bioprocess engineering**: Maintenance of sterile (microbial contamination-free) ambience in chemical engineering processes to enable growth of only the desired microbe/eukaryotic cell in large quantities for the manufacture of biotechnological products like antibiotics, vaccines, enzymes, etc.

Traditional hybridisation procedures used in plant and animal breeding, very often lead to inclusion and multiplication of undesirable genes along with the desired genes. The techniques of genetic engineering which include creation of recombinant DNA, use of gene cloning and gene transfer, overcome this limitation and allows us to isolate and introduce only one or a set of desirable genes without introducing undesirable genes into the target organism.

The construction of the first recombinant DNA emerged from the possibility of linking a gene encoding antibiotic resistance with a native plasmid (autonomously replicating circular extra-chromosomal DNA) of *Salmonella typhimurium*. Stanley Cohen and Herbert Boyer accomplished this in 1972 by isolating the antibiotic resistance gene by cutting out a piece of DNA from a plasmid which was responsible for conferring antibiotic resistance.

The cutting of DNA at specific locations became possible with the discovery of the so-called 'molecular scissors'— restriction enzymes. The cut piece of DNA was then linked with the plasmid DNA. These plasmid DNA act as vectors to transfer the piece of DNA attached to it. You probably know that mosquito acts as an insect vector to transfer the malarial parasite into human body. In the same way, a plasmid can be used as vector to deliver an alien piece of DNA into the host organism. The linking of antibiotic resistance gene with the plasmid vector became possible with the enzyme DNA ligase, which acts on cut DNA molecules and joins their ends. This makes a new combination of circular autonomously replicating DNA created in vitro and is known as recombinant DNA.