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Topic:	Genetic Recombination in Bacteria (Conjugation).
Lecture no.	15

Genetic Recombination in Bacteria: This is the process where genetic materials, contained in two separate genomes, are brought together within one unit. In bacteria, the genetic recombination takes place by:

(1). Transformation

(2).Transduction

(3).Conjugation.

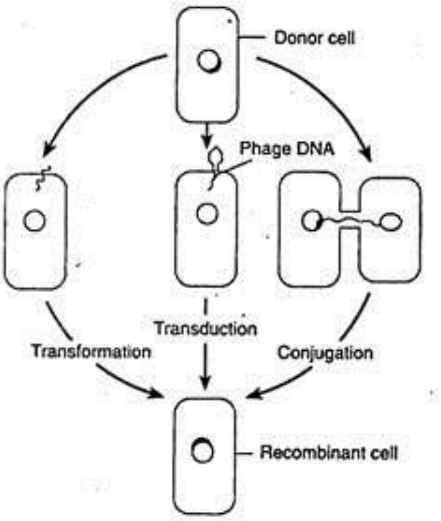

Fig. 2.25 : Different types of recombination

(1). Conjugation:

In this process, the exchange of genetic material takes place through a conjugation tube between the two cells of bacteria. The process was first postulated by Joshua Lederberg and Edward Tatum (1946) in Escherichia coli. They were awarded the Nobel Prize in 1958 for their work on bacterial genetics. Later on, it has also been demonstrated in Salmonella, Vibrio and Pseudomonas.

There are two mating types of bacteria, one is male type or F^+ or donor cell, which donates some DNA. The other one is female type or F^- or recipient cell, which receives DNA.

Later, after receiving DNA, the recipient cell may behave as donor cell i.e., F^+ type. The F-factor is the fertility factor, sex-factor or F-plasmid present in the cell of F^+ i.e., donor cell or male type. The plasmid takes part in conjugation is called episome.

In this process, two cells of opposite mating type i.e., F^+ and F^- become temporarily attached with each other by sex pilus (Fig. 2.26). The sex pilus has a

hole of 2.5 pm diameter through which DNA can pass from donor to recipient cell. The F-factor or F-plasmid is a double stranded DNA loop, present in the cytoplasm; apart from the nucleoid. The F-factor contains about 20 genes.

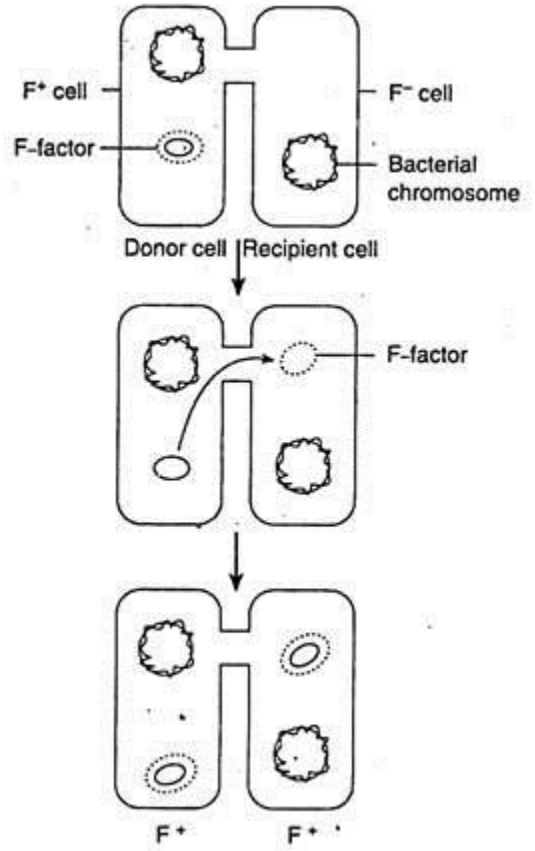

Fig. 2.26 : Recombination by F-factor in conjugation

After the establishment of conjugation tube, the F-factor prepares for replication by the rolling circular mechanism. The two strands of F- factor begin to separate from each other and one of them passes to the recipient i.e., F^- cell.

After reaching in F^- cell, enzymes synthesize a complementary strand that forms a double helix, which bends into a loop. The conversion process is thus completed. In the donor cell i.e., in F^+, a new DNA strand also forms to complement the left over DNA strand of the F-factor.

There is another type of conjugation where passage of nucleoid DNA takes place through conjugation tube. Strains of bacteria are known as Hfr (high frequency of

recombination) strain. William Hayes discovered such strains of E. coli in 1950s. The Hfr factor is also called episome. In Hfr strain, the F-factor is attached with the nucleoid DNA i.e., the bacterial chromosome.

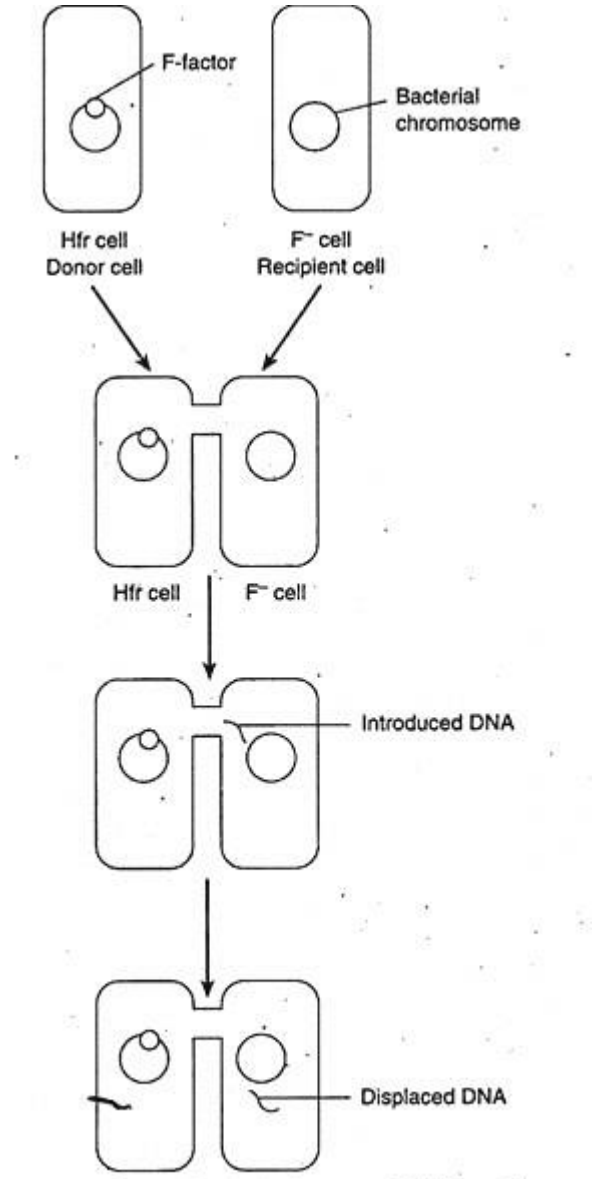

Fig. 2.27 : Recombination by fragment of DNA in conjugation

In this process, Hfr and F^- cells become attached with each other by sex pilus (Fig. 2.27). At the point of attachment of F-factor, the bacterial chromosome opens and a copy of one strand is formed by the rolling circular mechanism.

A portion of single stranded DNA then passes into the recipient cell through pilus. Due to agitation in medium, the conjugation tube may not survive for long time because of broken pilus. Thereby, the total length of transfer DNA may not be able to take entry to the recipient cell.

The behaviour of the transferred DNA depends on the presence and absence of F-factor:

If F-factor is indeed transferred, then it usually remains detached from the chromosome of recipient cell and enzymes synthesise a complementary DNA strand. The factor then forms a loop and exists as a plasmid, thereby the recipient cell becomes a donor.

If F-factor remains at the rear end of the transfer DNA during its entry to the recipient cell, the F-factor may not be able to take entry due to broken pilus and only a portion with new genes (Fig. 2.27) takes up the entry. Thereby, the F^- strain remains as recipient one. In F^- strain, genetic recombination takes place between donor fragment and recipient DNA.

iii) Sometimes, if the F-factor gets free from the Hfr cell and maintains an independent status, then the Hfr cell converts to a F^+ cell. Sometimes during the leaving of F-factor from the bacterial chromosome, it takes a segment of chromosomal DNA. The F-factor with segment of chromosomal DNA is called F'-factor.

Later on, during conjugation, when this F'-factor is transferred, the recipient cell receives some chromosomal DNA from the donor cell. This process is called sexduction. In this process, the recipient cell receives a portion of chromosomal DNA which duplicates with the existing one for a specific function, thereby the recipient cell is a partial diploid.

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