PG Sem 1
CC 3
Unit 2

Bacterial Conjugation

In 1946 Lederberg, established a process of conjugation in bacterial cell by physical contact between two genetically different bacterial cells of the same or closely related species. Conjugation can be defined as a transfer of genetic material from one cell to other by formation of a conjugation tube. The conjugation tube is formed by special appendages appendages called sex pili specified by a plasmid the F factor in the donor cell. The recipient cell have a specific receptor site for conjugation. It is to noted that there is no exchange of genetic material during conjugation, only unilateral transfer takes place between bacterial cell as they are haploid in nature.

Bacterial conjugation is a way by which a bacterial cell transfers genetic material to another bacterial cell. The genetic material that is transferred through bacterial conjugation is a small plasmid, Known as F- plasmid that carries genetic information different from that which is already present in the chromosome of the bacterial cell. In fact, the F plasmid can replicate in the cytoplasm seperately from the bacterial chromosome.

A cell that already has a copy of the F Plasmid is called as F- positive, F Plus or F^+ cell and is considered as a donor cell while a cell that does not have a copy of the F plasmid is called an F negative, F minus or F^- cell, and is considered as a recipient cell. The transfer of F plasmid takes place

a horizontal connection by which the donor cell and the recipient cell directly contact each other or form a bridge between the two through which the genetic material is transferred. In cases where F- plasmid of a donor cell has been integrated in the cell's genome (in chromosome) a part of the chromosomal DNA may also be transferred to the recipient cell together with F- plasmid -

Steps of Bacterial conjugation -

1) Pilus formation - In order to transfer the F plasmid, a donor cell and recipient cell first establishes a contact and forms pilus Donor cell F^+ cell produces the sex pilus, which is a structure that projects out of the cell and begins contact with an F^- recipient cell.

(2) II Physical contact between donor and recipient cell forms conjugation tube enabled by pilus!

(3) Transfer of F- Plasmid - F factor opens at replication origin (ori T site) and one strand of F factor is cut down at origin and 5' end of this strand enters into recipient cell.

(4) Complementary strand synthesis -

In the last step, the donor cell and the recipient cell both containing single stranded DNA of F- plasmid A complementary strand is then synthesized in both donor and recipient cell, now the recipient cell also contain a copy of F- plasmid and become a donor cell

become a donor cell.

Mechanism of conjugation - Conjugation is brought about by 2 genes in self transmissible plasmid, namely transacting gene (Tra gene) and origin of transfer (ori T) site.

1. Tra gene - Tra gene consists of 2 component Dtr and mpf.

(a) Dtr - (DNA transfer and replication component) It includes components such as relaxases, relaxosome complex and primase

Relaxase - Relaxase is a site specific endonuclease which acts on plasmid at its oriT site. it also recognises the plasmid after it has been transffered to the recipient cell. Relaxase is transcript transcribed along with plasmid into the recipient.

Relaxosome complex - It is a group of proteins clustered around the oriT site and carries three basic functions -

It helps relaxase to bind the oriT site and initiates plasmid transfer. it also communicates with the coupling protein of Mpf components unit which signals relaxase when to cut the plasmid of oriT site. Helicase is a componenent of relaxasome which helps to seperate the plasmid DNA strands during displacement and transfer of plasmid.

Primase - The free 3-OH end created at the nic site acts as a primer in donor cell it is transfered to the recipient cell and synthesizes a primer to complete the replication of another strand of plasmid DNA in recipient cell.

(iii) Mpf (Mating Pair formation) component -

Mpf component holds the donor and recipient cell together, forms a channel through which DNA is transferred and Signal Dtr component to initiate transfer. It has 3 components Pilus, channel and coupling protein.

Pilus - Pilus holds donor and recipient cell together, It is 10 nm in diameter, tubular structure with a central channel projecting out of cell surface, it may be structurally long, thin, flexible and it is encoded by F plasmid in those cell having liquid medium short thick and rigid pili mediates in cell fixed to solid support (Agar medium) Inc I plasmid encodes both long thin flexible pili and short thick rigid pili, conjugations in both liquid and solid media.

Channel → channel are enclosed by Tra gene it mediates the transfer of DNA from donor to recipient cell.

Coupling Proteins - Coupling proteins are associated with channel, it signals the relaxases which initiate the process of DNA transfer, it also determine the type of protein to be transported to the recipient cell. (Relaxase and primase)

(iii) Ori T site - It is the site where plasmid DNA transfer initiate in donor cells and the site for recyclization in the recipient cell. It is a cis-acting site and consist of 300 bp and inverted repeats and AT rich sites.

Chromosome transfer by plasmid takes place by its integration with chromosome which is called as Hfr or High frequency recombination plasmid can integrate into chromosome through 2 mechanism

① Recombination - Plasmid can combine with chromosome when plasmid and chromosome share common sequences (homologous sequences) Although the sequences of plasmid are unique to that of chromosome they share homology at certain insertion sequences

② Transposition - Plasmid can insert itself into chromosome by transposons and results in formation of Hfr.

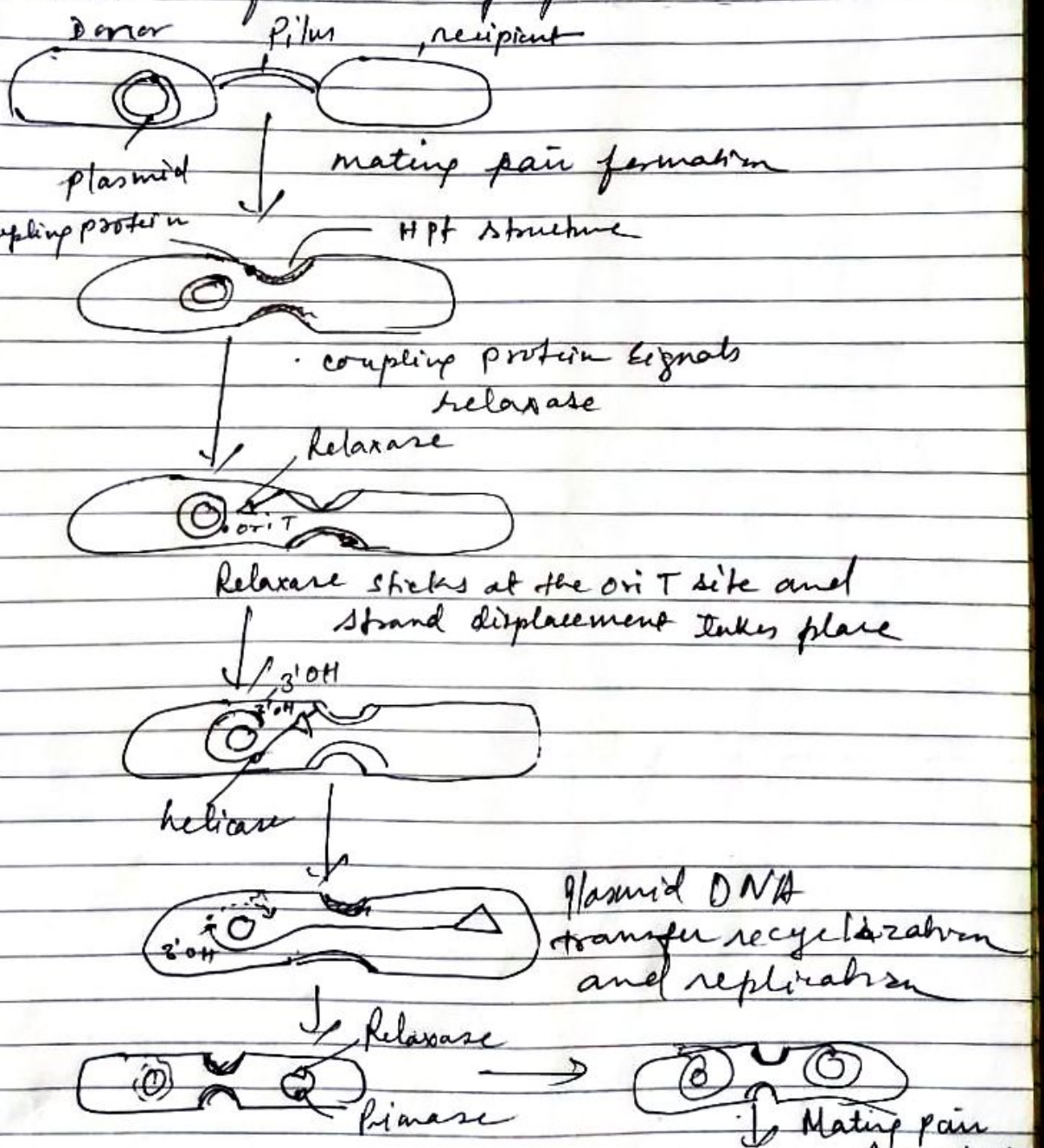

fig - showing steps of conjugation in Bacterial cell.